PLASTICS

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

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Irradiated Plastic Applications . . . . . page 52
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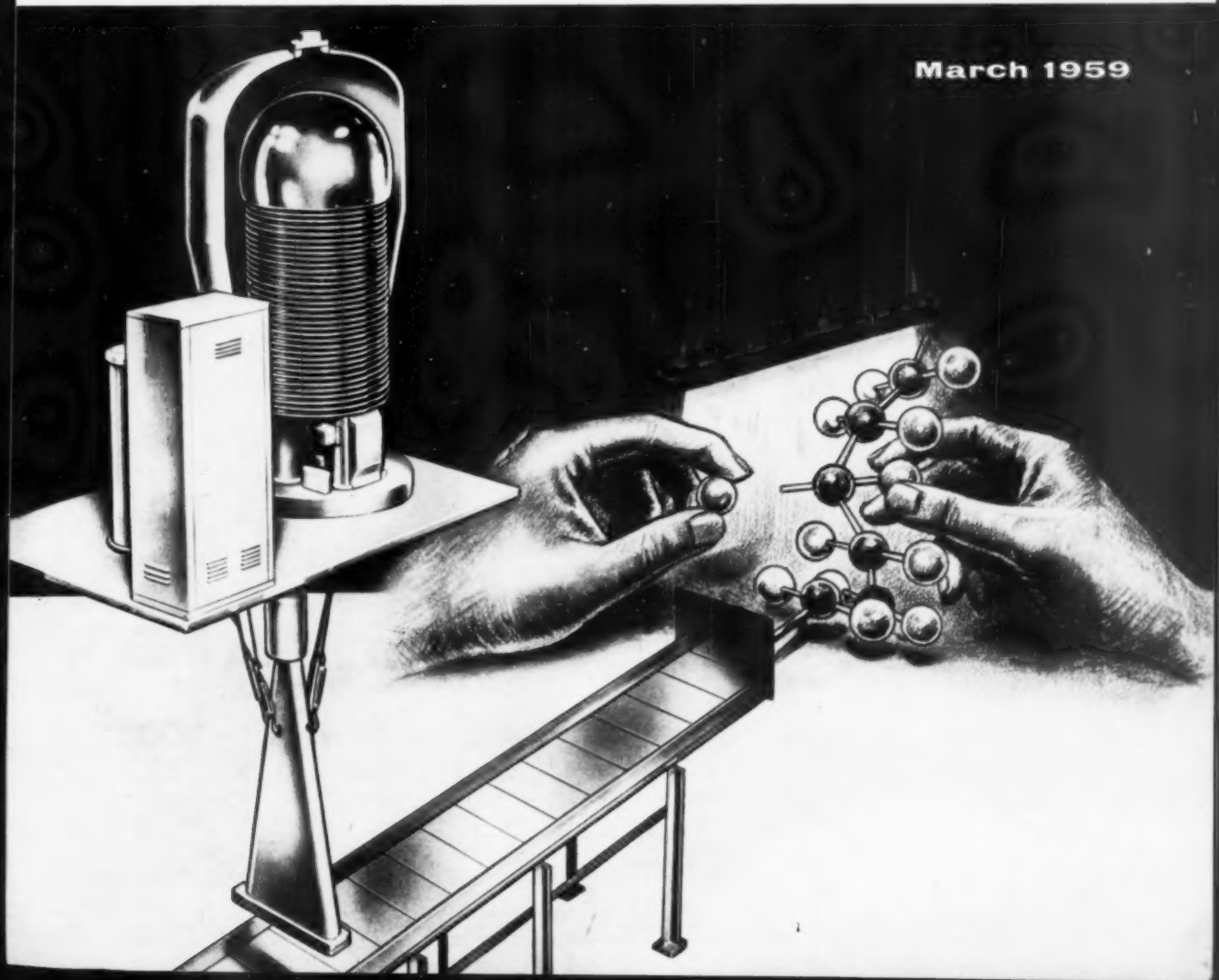
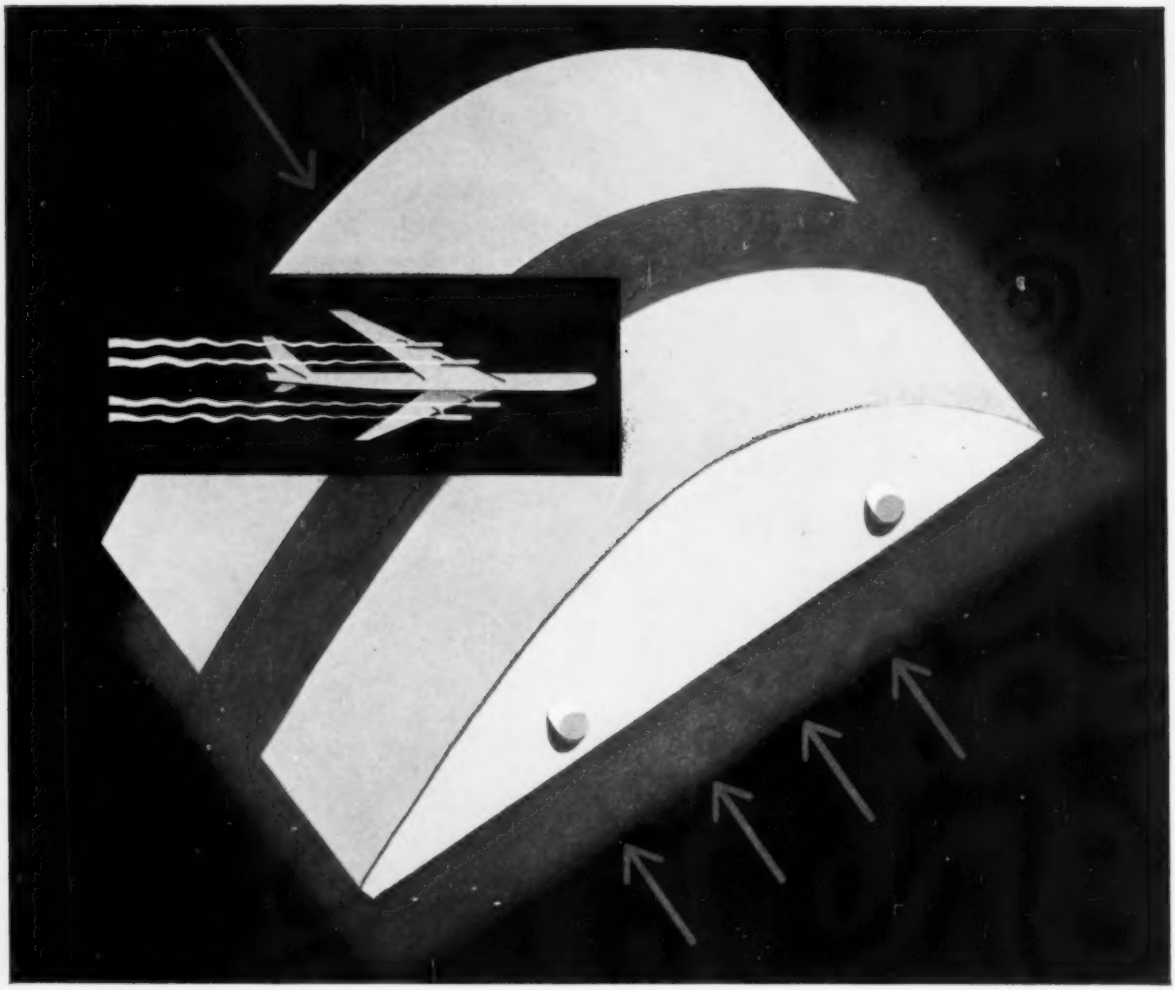


March 1959



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For versatile beauty... for supple strength... *Catalin* POLYETHYLENE

Sparking a responsive note from thrifty shoppers with an urge for self-expression and more imagination than money . . . "Decor-Weve" Flower Pot Holders by Nu-Dell* have hit the best-seller lists in gift and houseware departments everywhere.

Turned and twisted into fanciful shapes, they come through the ordeal handsomely because they are molded of flexible, sinewy, low-density CATALIN POLYETHYLENE.

As easily as the flexibility of "Decor-Weve" incites endless ideas in home decoration . . . so too can the wide range of low to high density CATALIN POLYETHYLENE formulations stimulate new, best-selling product ideas for designers and manufacturers.

From gymnastic bendability to outstanding rigidity, CATALIN POLYETHYLENE formulations span densities from .915 to .96, with melt indexes from 0.2 to 50. Within this broad spectrum, the specifications engineer can confidently select one to achieve the best possible results . . . whether by injection molding, blow molding or extrusion. Inquiries invited.

*Nu-Dell Plastics Corporation, 2250 North Pulaski Road, Chicago 39, Ill.

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

MARCH 1959 VOLUME V NUMBER 3

FEATURE ARTICLES:

LOW-DENSITY CELLULAR VINYL BY POST-EXPANSION METHODS p.27

By Donald Esagrove and R. J. Meyer

Materials (including resin, blowing agent, stabilizer, and lubricant) and equipment for making cellular vinyl by extrusion and calendering techniques are discussed in detail. Core materials, expansion ovens, supporting materials, and cooling and take-up equipment are described. Properties and applications for the cellular products also are covered.

COATINGS FOR VACUUM METALLIZING ON PLASTICS p.32

By M. A. Self and John Scharnberg

The application methods and formulations for the top and base coatings are discussed in detail, with emphasis on base coat problems; general properties and problems of the films; top and back-up coats; coating methods; and the future outlook.

COMPARISON OF PHENOLIC AND POLYESTER PREMIX MATERIALS p.36

By J. J. Calao and M. M. Gurvitch

Phenolic and polyester premix materials have many economic advantages. While they have many overlapping properties of interest to molders, each has unique advantages that should be considered carefully when deciding on specific applications to assure the most satisfactory performance.

OPTICAL PROPERTIES OF TRANSLUCENT, GLASS-REINFORCED PANELS p.42

By Daniel Smith and J. B. Crenshaw

In an investigation of optical properties of translucent panels made with unsaturated polyester resin containing acrylic monomers, the characteristics of scattered light (haze) were found to be most significant. The color, amount of color, and color purity of the scattered light were functions of the reinforcement components.

GUEST EDITORIAL:

DEVELOPING THE CUSTOM MOLDING MARKET p.41

By E. H. Thompson

ADVANCES IN THE TECHNOLOGY OF PLASTICS
DEVELOPMENTS IN PLASTICS MATERIALS—1958 p.55

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Need for a Plastics Institute

COMPRESSION & TRANSFER MOLDING p.60

By Paul E. Fina

Assignment: Empirical Cure Times in Phenolics!

EXPLORING FABRICATION TECHNIQUES
IRRADIATED PLASTIC APPLICATIONS: KAOLIN p.52

By L. J. Zukor

FEATURE STORY:

THE TIME ELEMENT IN HOT STAMPING p.49

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The opinions expressed by our contributors do not necessarily reflect those of our editors

Photo courtesy Capitol Records, Inc., Hollywood, Calif.

Sound Answer to a Record-Making Challenge

The rising tide of interest in stereophonic sound has record companies rushing to meet demand. But high-speed pressing of stereo presents a real challenge for the record maker.

Here's why: The needle, or stylus, moves both laterally *and* vertically in the grooves of a stereophonic record. With regular hi-fi, the stylus moves *only* from side to side. This means the grooves of a stereo record must be strong enough to do *twice* the work of standard high-fidelity grooves. Yet (*and this is vital*) quality of tone must not be impaired.

One major record company has answered this challenge with PLIOVIC, Goodyear vinyl resin. Not only does PLIOVIC toughen the grooves, it has improved compound flow during pressing–reduced flash, lowered rejects and made possible more efficient, more economical production. Most important of all–it has enhanced the illusion of "living sound."

Want to improve the quality–and sales appeal–of *your* product? PLIOVIC may well be the answer. For more information–plus latest *Tech Book Bulletins*–write Goodyear, Chemical Division, Dept. C-9441, Akron 16, Ohio.

GOODYEAR

CHEMICAL DIVISION

Pliovic –T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

Letters to the Editor

Previews of Next Month

The April issue will feature the following articles:

A New Look at Dry-Color Dispersion. A. R. Morse, Sales Engr., Injection Molders Supply Co., Cleveland, Ohio.

Problems involved in color-dispersion nozzles for injection molding are discussed in detail. Proper dry coloring is a complex problem that can depend on nozzle design, nozzle-mixing devices, heating cylinders and material-handling techniques, as well as on brands of material and colorant.

•

High-Density Cellular Vinyl by Direct Extrusion. R. J. Meyer, Sr. Devel. Engr., and Donald Esarove, Development Center, B. F. Goodrich Chemical Co., Avon Lake, Ohio.

Gas can be incorporated into vinyl by means of a direct-extrusion technique using conventional equipment. In this method, gas can be considered a filler that imparts unique properties and economic advantages, making it a more desirable loading agent than solid fillers for many applications.

•

Brushable Resurfacer for Fiberglass Panels. K. J. Berg, Chemist, and M. C. Slone, Tech. Director, Chemiglas, Inc., San Diego, Calif.

Results of a testing program are given to show the effects of the brushable refinishing coating for the panels. This coating is shown to give superior weathering properties, superior water and temperature resistances, and good light and heat transmission qualities.

•

Physical Properties of Premix Materials. H. R. Sheppard, Mgr. of Insulation Appl. Section, and R. H. Calderwood, Matls. Engr., Matls. Engineering Section, Westinghouse Electric Corp., Pittsburgh, Pa.

A study of glass-polyester premix materials molded by compression and transfer molding methods shows that impact strength, flexural strength, and fiber orientation of the resulting parts are affected by sprue diameter size and the method of molding.

Tarnishing of Bagged Parts

Dear Sir:

We have a problem which involves polyethylene and seek your advice.

We are electroplating many parts which are components of guided missiles and have no trouble whatever, with the exception of one. This part is heat-sealed in a polyethylene bag.

This particular part is a flat plate made of high quality 70-30 clock brass. We apply the following finish: flash copper (10-millionths thick), silver plate (five ten-thousandths thick), and gold plate (60-70 millionths thick). The parts are then wrapped in "Silver-Saver" paper, heat-sealed in polyethylene, and shipped from Minneapolis to Kansas City, Mo., by truck. They are in the bags about three weeks.

On opening, the parts are rejected due to surface discoloration. The colors are black, blue and red, with variations similar to the results of a drop of oil on water. The discolorations are spots up to ⅛-inch in diameter and quite numerous on some.

Frankly, we do not feel it is a common "spotting out" problem, familiar to the plating industry and due to lack of thorough rinsing, for several reasons (based on tests we have conducted).

We feel that possibly some gas may be evolved during the heat sealing and this is causing the discoloration. Another reason for the feeling that the base of the trouble lies in the polyethylene bag is that a large manufacturer of gyros has eliminated the polyethylene bagging of this part due to corrosion difficulties encountered in the field. Since this elimination, they have encountered no trouble.

We realize, of course, that our thinking is adverse to polyethylene, and that we may be entirely wrong. However, this discoloration is occuring in many sections of the country and is playing hob with missile production due to this bottleneck in the result of plating. Any help or suggestions you can make to prove or disprove this theory will be appreciated.

F. J. Kaim, Res. & Devel. Engr.,
Superior Plating, Inc.
Minneapolis 14, Minn.

(What do our readers say?—Editor)

"Extrusion Theory" Article

Dear Sir:

I would like to obtain a copy of the article "Extrusion Theory," Parts I and II, which were published in your December, 1958 and January, 1959 issues.

O. W. Grant, Sales Engineer,
John Waldron Corp.
New Brunswick, N. J.

Dear Sir:

If at all possible, we would appreciate receiving several reprints of your recent article, "Extrusion Theory — Parts I and II." Several of our people keep their own notebooks or files on extrusion subject matter and copies of this article would be very appropriate.

A. F. Hardman, Jr.
Hale and Kullgren, Inc.
Akron, Ohio

(We print these two letters only to illustrate the many hundreds received here commenting on the importance and value of proper "Extrusion Theory." —Editor)

• • •

Information Wanted

Dear Sir:

In connection with the chemical feeder pumps that we manufacture, we require plastic tubing and plastic fittings. The tubing size is ¼-inch O. D., and the fittings, both elbow and straight ones, are to have the tubing connection on one end, and the other ends are to be ⅛-inch male pipe thread.

We are wondering if you would be kind enough to supply us with a list of the manufacturers who make such fittings, as we are looking for a source of this material.

A. S. Limpert, Pres.
Limpert Laboratory, Inc.
Bay Shore, N. Y.

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

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Designed and recommended for the production of components for domestic clothes-washers and dishwashers . . . such as agitators, pump housings, silverware baskets, detergent dispensers, and fittings, as well as other applications such as humidifiers, requiring similar operating conditions:

CORROSION RESISTANCE to effects of detergents, soaps and bleaches.

IMPACT RESISTANCE to reduce breakage during service should components that are handled be inadvertently dropped. (Plenco 417, minimum impact strength 0.50 ft. lbs. per in. of notch; Plenco 476-A, a similar but lower cost compound, impact strength value 0.39 ft. lbs. per in. of notch.)

SURFACE HARDNESS to provide maximum erosion resistance to abrasives.

DIMENSIONAL STABILITY to effects of elevated temperatures in washing, drying, evaporating environments.

CRACKING RESISTANCE to effects of minute but repeated surface dimensional change due to fiber moisture gain and loss and thermo-expansion and contraction. Both 417 and 476-A can be depended upon for superior cracking resistance to repeated cycling under wet-dry hot-cold conditions. Our technical staff is prepared to consult with you at your convenience about these Plenco compounds or any other molding materials or problems.

IF PHENOLICS CAN DO IT

plenco

CAN PROVIDE IT

already-made or specially-made

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FOR BETTER PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

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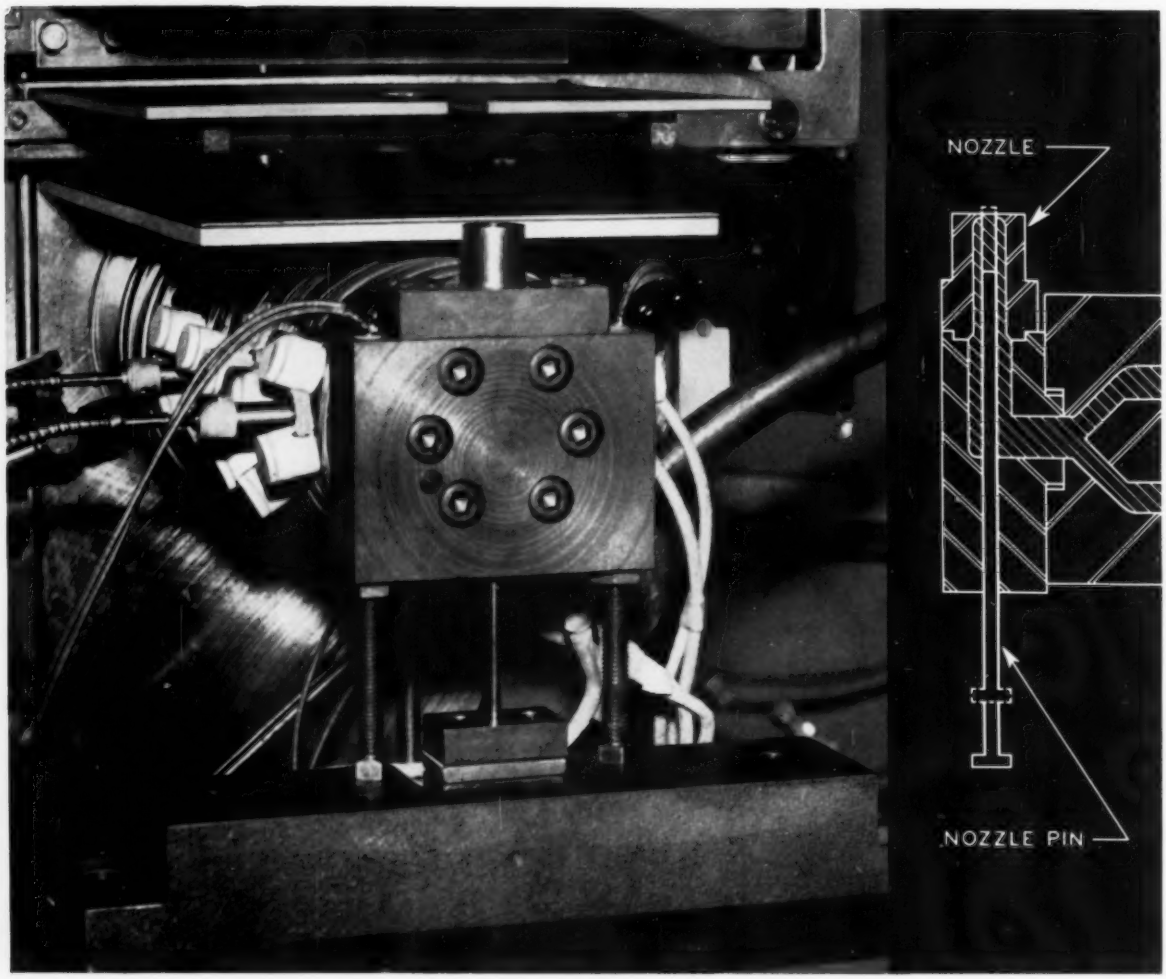

STOKES *exclusive* nozzle shut-off... for precompressed injection molding!

Here are five important reasons why this exclusive Stokes feature increases the efficiency of injection molding:

- Provides precompressed material in the heating cylinder
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- Increases plasticizing capacity
- Provides faster filling of cavities
- Completely eliminates nozzle "drool" and "strings"

This exclusive feature is typical of the unique Stokes injection molding concept. Do you have all the facts on *positive ejection* and *truly automatic molding?* Write, today.

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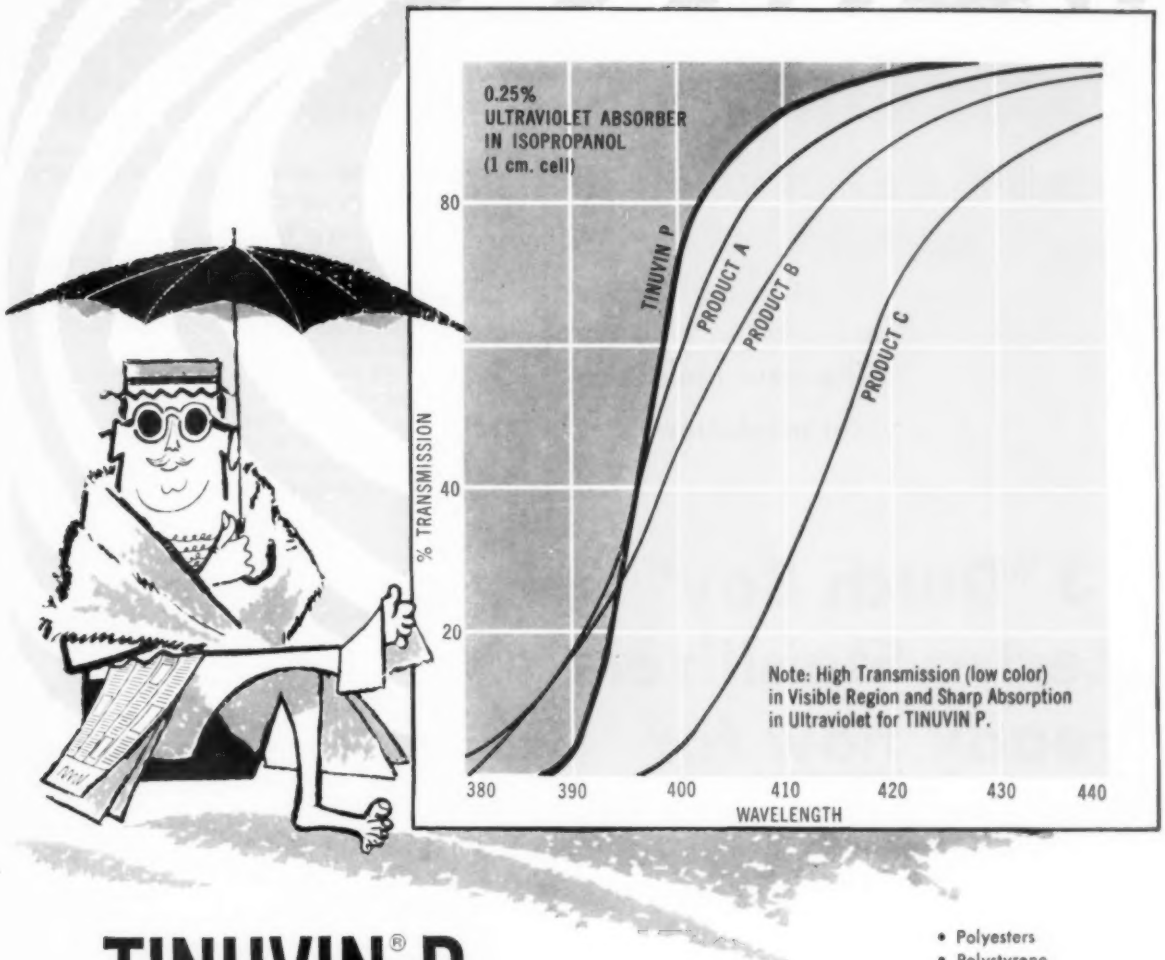

TINUVIN® P

protects against ultraviolet radiation

TINUVIN P (CH3457) is a new *Benzotriazole* Ultraviolet Absorber for protection of plastics and other products affected by actinic radiation. TINUVIN P combines superior light, heat and chemical stability with maximum ultraviolet absorption without yellowing. *(pat. appl.)*

Write for sample and data sheet today

SUGGESTED APPLICATIONS

- Polyesters
- Polystyrene
- Acrylates
- Polyvinyl Chloride
- Polyvinylidene Chloride
- Polyvinyl Butyral
- Alkyds
- Polyamides
- Cellulose Esters
- Ethyl Cellulose
- Packaging Film
- All Extended Rubber
- Plastic and Silicone Coated Glass
- Synthetic Fibers
- Rayon
- Lacquers, Varnishes
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New Lectro* 78...

105° and experimental higher rated wire

Stabilizer for severe heat service conditions

Lectro **78** is a new "Dutch Boy" lead stabilizer developed particularly for high temperature vinyl insulations. Tests indicate (1) it stabilizes against extreme processing temperatures without gassing; (2) it imparts exceptional heat service life.

Lectro **78** sets new highs for volume resistivity over a range of temperatures in tests made according to Underwriters' Laboratory procedures on T, TW, 90°C and 105°C coated wire. In the same series it shows outstanding moisture resistance, as well.

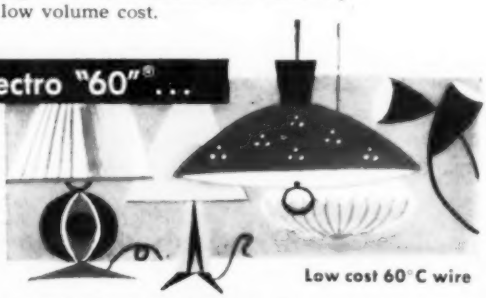
New Lectro* 77...

Special purpose 60°-80°C wire

A most versatile insulation stabilizer

Lectro **77** ... another new "Dutch Boy" lead stabilizer ... promises unique versatility. For one thing it is an unsually good stabilizer with phthalate and many special purpose plasticizers. Secondly it provides excellent resistivity and outstanding moisture resistance at unusually low volume cost.

Lectro "60"®...



Low cost 60°C wire

"Dutch Boy" Stabilizer. For lowest volume cost

In 60°C wire, Lectro **60** lead stabilizer provides much the same benefits as Lectro **77** ... combined with rock bottom volume cost.

U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

MARCH, 1959 U.S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

New bread-wrap material is a sulphite-base sheet with an inner coating of polyethylene. The outer surface has a high gloss finish coating. The extruded poly inner surface provides an excellent air-moisture barrier. The sheet withstands the relatively high temperatures of wrapping hot bread and reportedly performs well on existing wrapping machinery.

Amber polyethylene containers are now being used to market photographic and other light-sensitive materials, according to a recent announcement. Lightweight, unbreakable and chemically inert, the containers provide light protection but still allow the user to see the level of the contents. Polyethylene's flexibility is said to be another advantage: Air can be removed and oxidation of the contents prevented by squeezing the bottle and replacing the cap to form a vacuum container.

Poly film and poly-coated corrugated board are combined in a new type of package. The packaged item is encased by vacuum-forming in tight fitting film which is bonded to the mounting board. The board is folded along scored lines and inserted into an outer sleeve of corrugated board for shipping. The method is said to be suitable for a wide variety of packaging applications, ranging from costly, fragile industrial parts to volume-marketed consumer products.

A new adhesive for laminating polyethylene to burlap and other fabrics has been developed. It is expected to be helpful to bag makers and shoe manufacturers seeking to laminate polyethylene with a wet adhesive instead of heat sealing. The adhesive is said to be particularly useful in the manufacture of bags used for fertilizer and feeds.

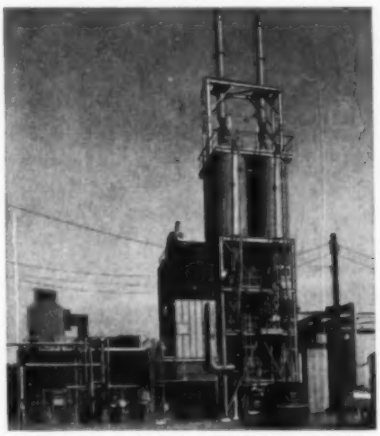
Machine which sets up tuck lid, poly-coated, bleached sulfate boxes and trays reportedly can produce up to 3000 units per hour. The machine heat-seals the box corners on the inside, leaving the exterior smooth and flat. Boxes and trays made by the machine are being used to package frozen foods, bakery products, candy, fresh foods and industrial parts.

A new polyethylene bottle with a rotating sleeve, also of polyethylene, has been designed to solve the problem of labeling. A horizontal channel for the sleeve is molded around the outside of the bottle. A paper label can be inserted in a vertical opening in the sleeve which is then rotated to cover the label. Inside the channel and protected by the sleeve, the label cannot fall off or be damaged by splashing liquids.

U.S.I. Starts Up New Plant at Tuscola For Compounding Petrothene® Resins

To Process 25 Million Lbs. of Resin Per Year

A new plant for compounding polyethylene resins with carbon black and other additives has been opened by U.S.I. at its petrochemical complex at Tuscola, Ill. The plant, which will handle 25 million pounds of resin a year, enables U.S.I. to assure its resin customers of even higher quality control than previously.



U.S.I.'s new polyethylene resin compounding plant at Tuscola, Ill., will handle 25 million pounds of resin a year.

In polyethylene pipe and electrical applications, the care with which carbon black is compounded with the resin has an important effect on the weather resistance of the finished product.

Weather resistance of a polyethylene compound depends on three factors: (1) type and particle size of carbon black; (2) percentage of carbon black in the compound; (3) dispersion of the carbon black in the compound.

Dispersion is particularly important. Tests show that good dispersion will enable polyethylene to withstand 15 to 20 times as much exposure as polyethylene with poorly dispersed carbon black.

At U.S.I.'s new compounding plant, only the finest channel black is employed in compounding the wire and cable grades of PETROTHENE resins. Concentration is set at a point which yields the optimum balance of light screening and other properties. Special processing equipment insures thorough dispersion.

Users of black electrical grade polyethylene can get technical data on PETROTHENE resins expressly formulated for electrical applications by contacting their nearest U.S.I. office.

Booklet Lists U.S.I. Resins For Wire, Cable Industry

U.S.I. has issued a four-page booklet classifying the special physical and electrical properties of PETROTHENE polyethylene resins. The booklet lists resins by application, essential properties, and industry specifications. Copies may be obtained by writing to Editor, U.S.I. Polyethylene News, U.S. Industrial Chemicals Co., 99 Park Avenue, New York 16, N. Y.

U.S.I. To Show Cast Film at Packaging Show

Ultra-clear cast film, printed film and other special packaging films will be featured in U.S.I.'s exhibit at the 28th AMA National Packaging Show in the Chicago International Amphitheatre, April 13-16. A team of technical service engineers will also be on hand at the U.S.I. booth (booth No. 1133-1135) to answer questions on packaging applications of films made from PETROTHENE polyethylene resins.

Injection-Mold Poly Tanks With 31-Gallon Capacity

Polyethylene tanks with a capacity of 31 gallons are now being injection-molded for use as salt storage containers for automatic water softeners. The 100-ounce tanks are believed to be among the largest deep-draft parts ever produced by the injection process.

The poly brine tanks measure 21 inches deep, with a maximum diameter of 21 inches. Designed with a two degree draft, they may be nested for economical shipment and storage. The tanks are molded on a specially modified 200-ounce injection machine which operates on a molding cycle of better than 20 shots per hour. The corrosion-resistant, dent-proof polyethylene tanks replace galvanized steel containers formerly used for this application.

U.S.I.

Vol. IV, No. 2

POLYETHYLENE PROCESSING TIPS

CAST FILM PROCESS GIVES TOP CLARITY FILM

Film extruders seeking greater clarity and gloss should investigate the cast film process. With this technique, you can produce polyethylene film with clarity equal or superior to that of other commonly used transparent packaging materials.

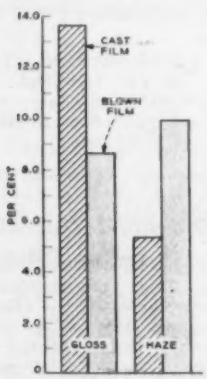
Casting Procedure

Casting involves extruding a molten web of polyethylene on a mirror-finished, water-cooled roll. Either standard flat-film extrusion equipment or conventional extrusion coating equipment can be modified for use with the new process.

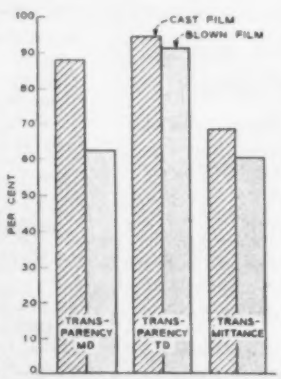
The melt is extruded through a slot die onto chrome-plated chilled rolls where it cools rapidly and solidifies. Under tension maintained by a driven windup roll and guide bars, the film is transferred at controlled speed over idler bars to a razor or score-cut slitter roll. The idler rolls permit further cooling before winding; and in trimming ½" to 1" from the film edges, the slitters remove the bead from the film edge.

Relation Between Properties and Process

Cast film has outstanding optical properties because the process controls the two principal causes of haziness in polyethylene film: surface roughness, which diffuses light passing through the film; and a partly amorphous-partly crystalline resin structure, which results in uneven light diffraction.



Comparison of optical properties (gloss & haze) of cast film vs. blown film (angle of incidence = 60°)



Comparison of optical properties (transparency & transmittance) of cast film vs. blown film

The casting roll surface determines the surface characteristics of the film. Consequently, cast film has as smooth a surface as the highly polished rolls whose contour it follows.

Haze-producing crystals in the matrix of the polyethylene are held to a minimum by keeping the film at high temperature until it hits the chill roll. The more rapid the cooling rate, the fewer the crystals and the smaller the spherulites – and the clearer the film.

Optimum Operating Conditions

Efficient production rates – generally faster than conventional methods – can be achieved by a proper balance of operating variables.

A die setting of 10 to 20 mils is recommended. A lower setting produces higher gloss and a significant reduction in neck-in tendency, but more blocking. Keeping the draw-down distance between the die lip and chill roll to a minimum also reduces neck-in, thereby making it easier to attain uniform gauge.

Excellent gauge control is possible in a range of film widths and in gauges from 0.5 to 4.5 mils. As gauge increases, a reduction in blocking occurs.

As low a stock temperature as possible will give best results for blocking and neck-in properties. Since gloss is impaired at low stock temperatures, the minimum temperature should probably be not less than 400°F.

A uniform "frost line" must be maintained as the film is cast. This is an indication that the melt is solidifying uniformly, that gauge is uniform, and that there will be no puckering or warping of film. It is achieved by balancing the chill roll temperature with the lineal speed and gauge of the film being extruded.

Sealing characteristics of cast film are not critical in either transverse or machine direction. Transverse-direction seals require a higher sealing temperature.

Choice of Resin

Lower density resins generally can be extruded into films with good optical properties by the cast film technique. It is therefore not necessary to make a large sacrifice of strength for clarity. PETROTHENE® 239 has been found to have the combination of properties most extruders require for such applications as overwrap, bread wrap and soft goods bags.

U.S.I. has pioneered in the cast film process, and is continuing to work in the lab and in the field on improvements in production methods. Our engineers will be glad to assist you in evaluating this new technique in your operations. Contact your nearest U.S.I. office or write:

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Division of National Distillers and Chemical Corporation
99 Park Ave., New York 16, N.Y.
Branches in principal cities

PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

MARCH, 1959

EDITORIAL: The Magazine—This Issue and the Future

We would like to devote this space to comments on the magazine's new appearance and changes still to come this year, as well as comments on some of the material appearing in this issue as part of the New Look.

By this time, our new Cover, Contents Page, and "News of the Industry" formats, and the more modern, less delicate type faces used for titles and heads in the technical articles should have become more familiar to you. How do you like them?

Future changes or modifications on tap for this year, to be put into effect as soon as mechanical problems are solved, include the use of a more modern type face throughout the entire magazine; better, more distinctive heads for the Departments; and a general improvement in appearance and quality of the entire magazine.

●

The subjects of the technical articles in this issue, as in the past, have been chosen for their importance and value not only currently, but also to serve as landmarks in the literature for work still in progress that will make its true importance felt in the near future. In other words, each article subject is worthy of careful consideration.

To carry this thought further, we respect the confidences given us, and try to avoid premature publication of material that is disclosed too hastily and contains information that is only half-baked, at best. We endeavor to have the articles appear in as finished a form as possible, and foresee and answer the questions that arise in the reader's mind.

The only category in the magazine where speed of publication is of the essence is the industry news department. All other sections stress completeness; the "mostest," not the "fustest." Accordingly, the write-ups in our New Materials, New Equipment, and Plastics Applications departments stress additional data that answers readers' questions arising from a more perfunctory treatment.

●

In this issue, we want to make special mention of some things to be read carefully and pondered deeply. The technical articles are important—enough said! Lee Zukor's column, "Exploring Fabrication Techniques," was a prime causative factor in the recent breakthrough on blow molding machines and methods.

Paul Fina's Engineering Forum on Compression & Transfer Molding points up the renaissance now under way in this field of plastics processing. Harry Douglas' Engineering Forum stresses the industry's need for a Plastics Institute. Finally, but not lastly, is the thought-provoking Guest Editorial on "Developing the Custom Molding Market."

Arthur M. Merrill
Editor

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HEATING CYLINDERS
SUCCESS 1958

NOW—trapped gas and air can be removed from the injection machine cylinder during the molding process! Imagine it! A devolatalizing heater for use right on your standard injection machine!

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**Patent Pending*

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Periodic Chart of the Atoms. Copyright W. M. Welch Mfg. Company, Chicago

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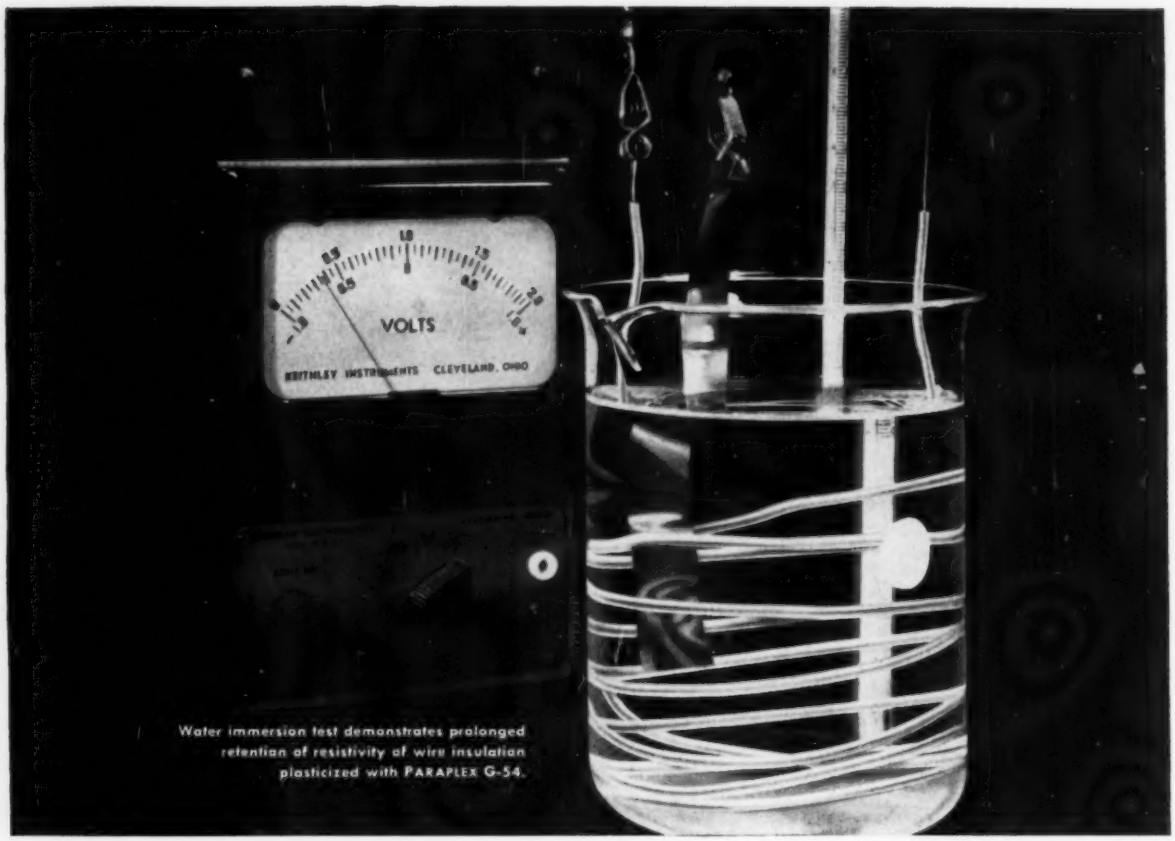
Rep's: H. M. Royal, Inc., 4814 Loma Vista Ave., Los Angeles; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal.



Water immersion test demonstrates prolonged retention of resistivity of wire insulation plasticized with PARAPLEX G-54.

PARAPLEX G-54...for vinyl insulation that resists high humidity at high temperatures

Vinyl insulation plasticized with PARAPLEX G-54 gives admirable service under "wet" conditions. This high molecular weight polymer keeps vinyl compounds flexible after prolonged high-temperature aging, as well as free from plasticizer exudation on exposure to high humidity at high temperatures.

In addition, compounds plasticized with PARAPLEX G-54 show good volume resistivity . . . high dry-dielectric strength . . . retention of dielectric strength after immersion in water . . . resistance to copper corrosion . . . resistance to plasticizer extraction by oil and soapy water . . . resistance to plasticizer migration into lacquers, baked enamels, polystyrene, and rubber . . . resilience . . . good low-temperature flexibility . . . and exceptional compatibility with epoxide plasticizers.

MONOPLEX S-90 is another Rohm & Haas plasticizer which imparts outstanding electrical characteristics to polyvinyl chloride. This high-molecular-weight, monomeric plasticizer provides high insulation resistance at elevated temperatures (both dry and after immersion in water), retention of tensile strength and elongation after high-temperature aging, and low plasticizer volatility. Write today for more information on these products and the other Rohm & Haas PARAPLEX and MONOPLEX plasticizers.

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Chemicals for Industry

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THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

PARAPLEX G-54

NEWS in BRIEF

Glass-reinforced polyester lifeboats have been approved by the U. S. Coast Guard for use on all American passenger and cargo vessels. The boats passed the most severe tests ever given to any type of lifeboat, simulating the worst conceivable sea conditions.

Almost every industry is a potential customer for molded plastics, says E. H. Thompson, V-P for Prolon Plastics (see Guest Editorial, page 41). He describes eight potential fields of interest, and lists seven facts that should be studied before deciding on the field to be entered. Following this, he gives five methods by which a working program can be established to develop a custom molding market.

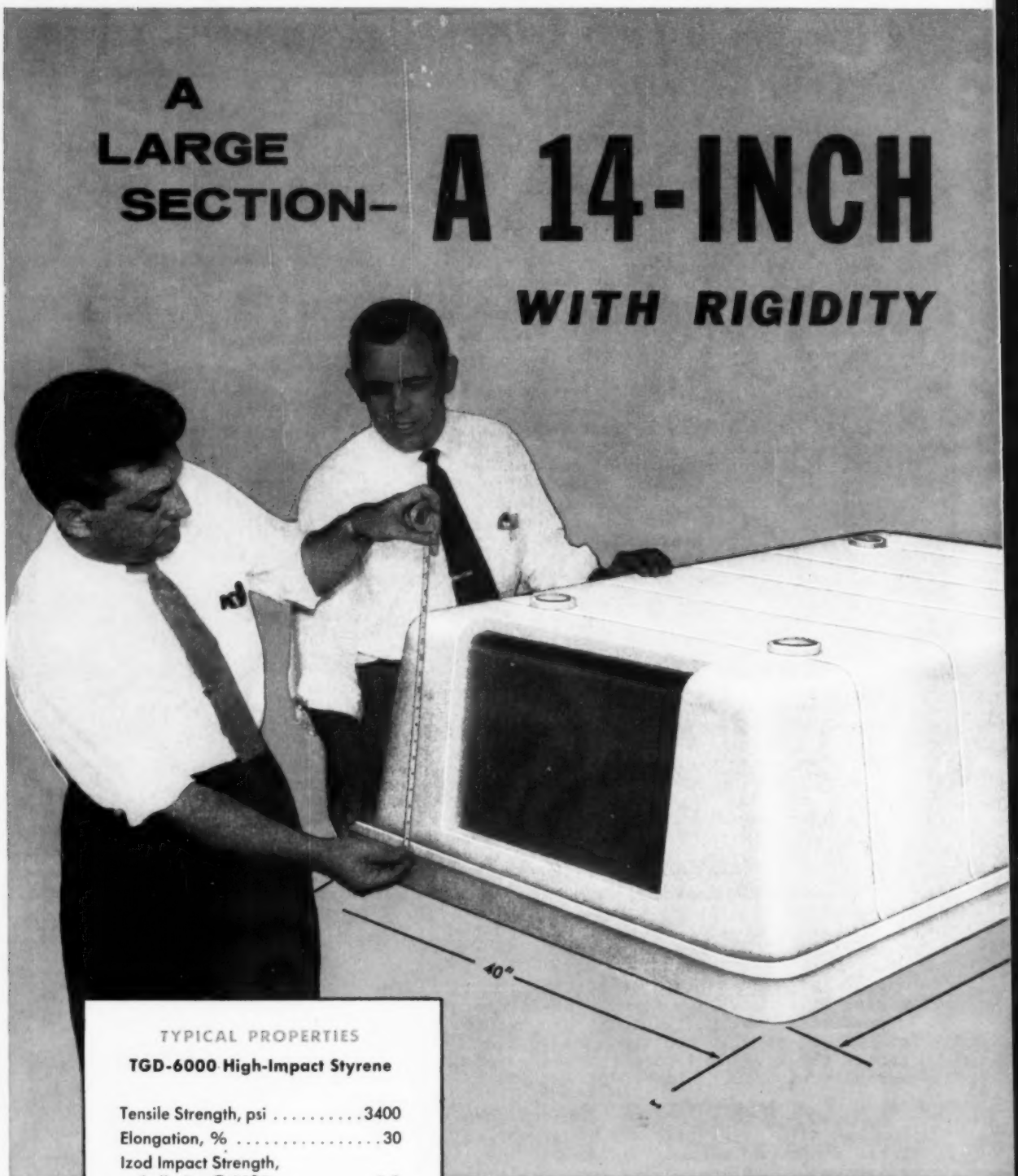
Business developments in the plastics industry continue in full fettle. AviSun Corp., equally-owned by American Viscose Corp. and Sun Oil Co., is expected to be the largest commercial producer of polypropylene plastic material in this country by mid-summer. Fome-Cor Corp. is the new firm formed by St. Regis Paper and Monsanto to make sandwich laminates of foamed plastic and paper by a continuous process. General Electric reorganized its corporate set-up. Hastings Plastics became exclusive distributor of Reichhold's plastic resins for aircraft and missile applications in Southern California. Hooker has divisionalized further. Johns-Manville Fiber Glass took over seven Fiberglass plants and a research & technical center. Nosco Plastics was sold to Holgate Brother Co. Rexall Drug completed negotiations for the acquisition of Chippewa Plastics, Inc. Spencer Chemical and Industrial Rayon Corp. have cancelled their plans to construct a plant to manufacture caprolactam, a material used in the manufacture of nylon.

Company expansions in plastics remain in the news this month. A new lab will be built by American Cyanamid in Wallingford, Conn. Automold Co. is the new name for Automatic Molding Machine Co., which moved to new and larger quarters in West Los Angeles, Calif. Commercial Plastics & Supply moved to larger facilities in Pittsburgh, Pa. Continental-Diamond plans to build a research center in Newark, Del. Extrudo-Film is erecting its second polyethylene plant in Pottstown, Pa. Glascoat moved into new facilities in North Miami, Fla. Hooker opened its new research center on Grand Island, N. Y. J. M. Huber moved into new quarters in New York City. Mobay plans a 50% expansion in toluethylene diisocyanate production at New Martinsville, W. Va. Monsanto will expand its high-pressure polyethylene facilities in Texas City, Tex. Nopco will triple the size of its present plant in North Arlington, N. J., producing urethane foams. Ryko Products is expanding its extrusion and fabrication facilities in Los Angeles, Calif. Tennessee Eastman enlarged its development lab in Kingsport, Tenn. Union Carbide will build a new poyethylene film plant in Cartersville, Ga.

New Materials of special interest (see pages 72-74): polyether for making rigid urethane foams; TFE-fluorocarbon resin; epoxy putty of low volume resistivity; toluidine accelerator for benzoyl peroxide-catalyzed reactions; acrylic copolymer resin solution; high temperature-resistant adhesive for bonding Teflon surfaces; cobalt curing agent for polyesters; and a lapping/polishing compound.

New Equipment to be noted (see pages 76-78): 300-oz. injection machine with preplasticizer; four-oz. automatic injection machine; single table drape and vacuum forming machine; temperature-humidity environmental cabinets; and side-loading pipe pullers.

Plastics Applications that merit attention (see pages 79-84): aspirator pump of polyethylene; fabric-filled phenolic rigging block for sailboats; clear polystyrene compartmented boxes; world's largest reinforced plastic radome; glass-polyester insulators for electrical uses; do-it-yourself vinyl wall paneling; molded nylon clips for holding window screens or storm panels; pressure-sensitive adhesive for laminations to foam materials; resin-rubber impellers for pumps; series of hexagonal, molded nylon nuts; and a new series of reinforced-plastic boats.



TYPICAL PROPERTIES

TGD-6000 High-Impact Styrene

Tensile Strength, psi	3400
Elongation, %	30
Izod Impact Strength, ft. lb./in. @ 23°C.	1.0
@ 0°C.	0.85
Modulus of Elasticity in Flexure, psi x 10^5	3.6
Flexural Strength, psi	8000
Hardness, Durometer, D	80

BAKELITE
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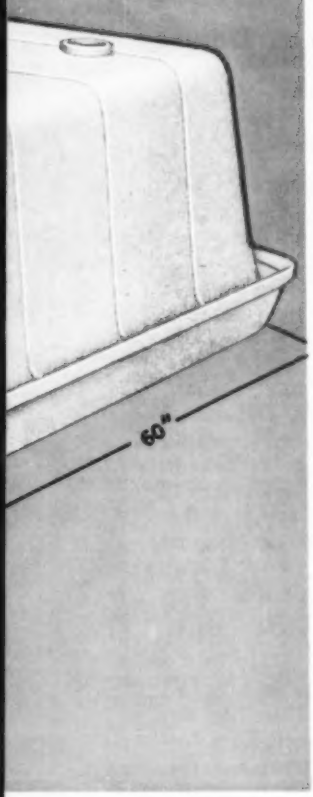
DEEP DRAW—

AND TOUGHNESS MAINTAINED!



How could *your* product or part be made better by a BAKELITE Brand Plastic? Consider the all-around advantages gained by Almor Corporation, Van Dyke, Mich., for its new line of produce display tables . . .

A 30% saving (over former materials) was an immediate result of Almor's change to BAKELITE Brand TGD-6000 high-impact styrene. This change followed extensive tests which proved that the large table sections could be vacuum-formed directly from sheets 38½" x 58" x 125 mil., with virtually no loss in strength and rigidity, *even when deep-drawn to 14 inches!*

Besides a high degree of formability, TGD-6000 provides surface hardness and high gloss for modern, easy-to-clean appearance and maintenance—with uniform, integral color free from streaking.

For technical data on TGD-6000 or any of the other BAKELITE Brand Styrenes, contact your Technical Representative or write Dept. CQ-37H

Completed "Almor" display table for large super-markets consists of a 3-inch tray top and a 14-inch deep base, both vacuum formed of BAKELITE Brand TGD-6000 Styrene. The 14-inch draw is done with a plug assist. Kal Plastics, Beaverton, Michigan extruded the sheet of BAKELITE Brand TGD-6000 Styrene which was vacuum formed by Imperial Industries, Wayne, Michigan. Table designed by Irving Stollman.

UNION CARBIDE PLASTICS COMPANY

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UNION CARBIDE

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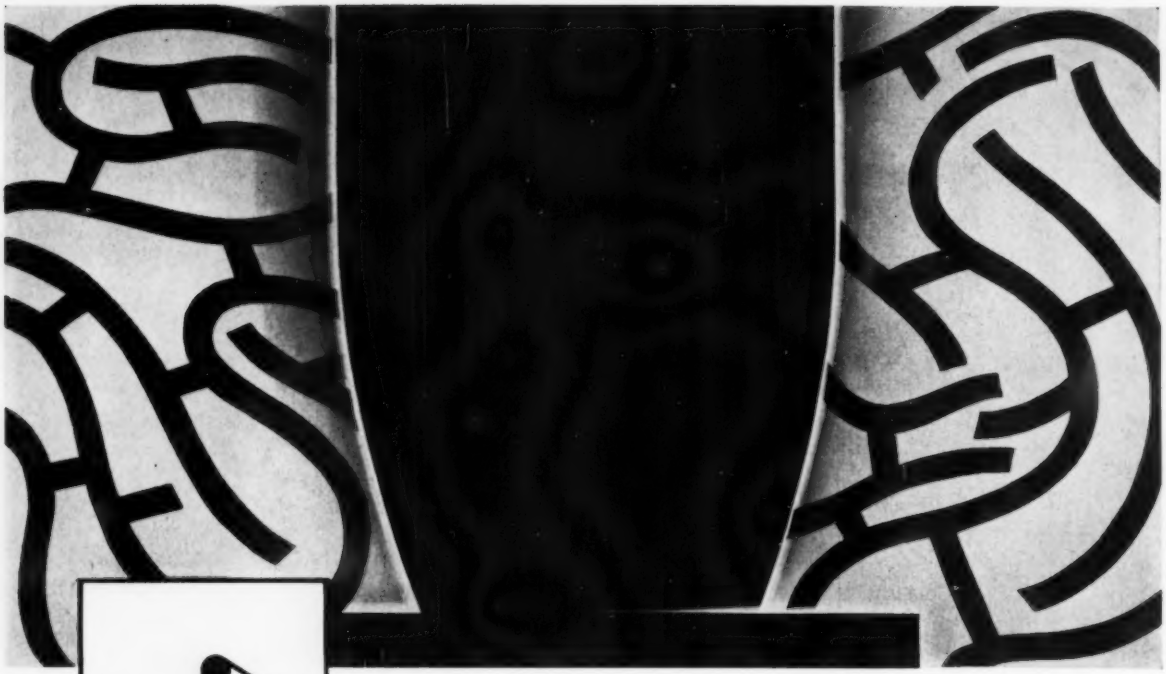

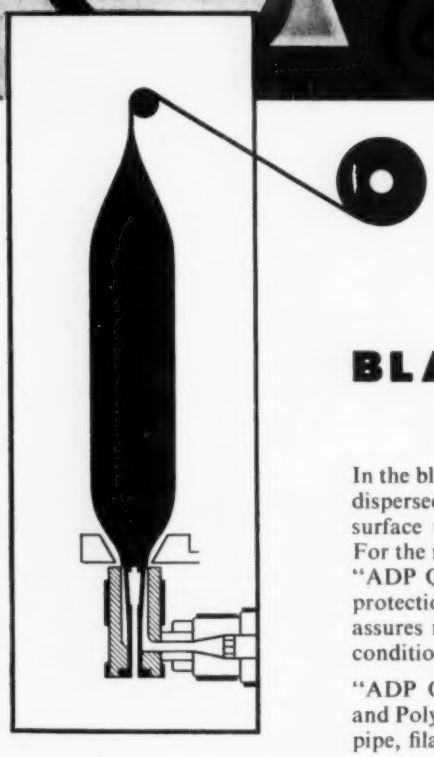

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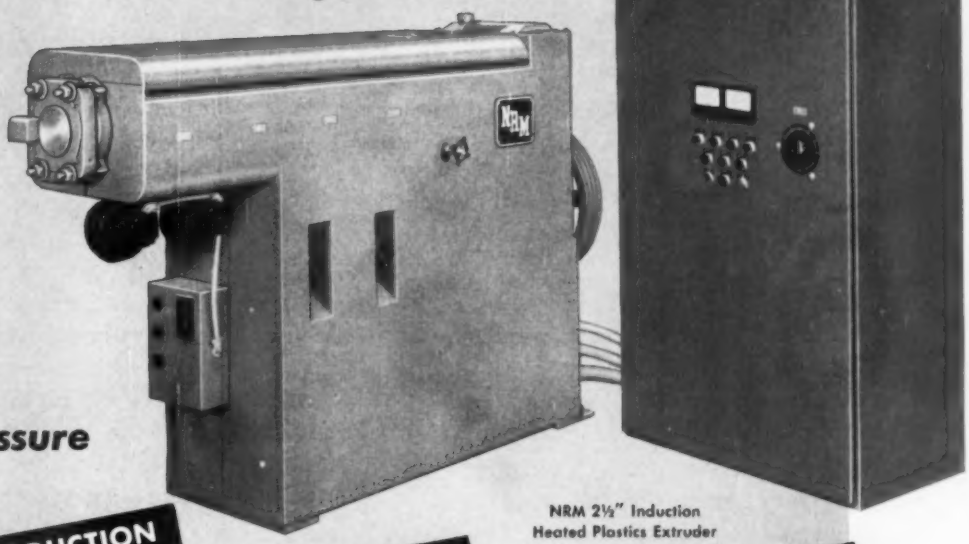

NRM 2½" Induction Heated Plastics Extruder

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for NRM *Thermoplastics* EXTRUDERS

To have profit-making advantages like these *always* at highest peaks of effectiveness in its Extruders, NRM has always searched aggressively for the "better way" to extrude thermoplastics. In this spirit, NRM pioneered development of high speed extrusion, and in January, 1956, made commercially available the first machines *specially* designed to extrude at high screw speeds. They set new concepts in higher quality extrusions at higher lbs/hr rates . . . typical production for a 2½" High Speed NRM Model 50 with 25 h.p. drive extruding Polyethylene pipe being 184 lbs/hr at 148 r.p.m., as compared to 100 lbs/hr at 72 r.p.m. for standard machines with 15 h.p. drive.

Today, NRM Extruders are available to provide the increased production advantages of high screw speeds which so short a time ago was *new* development, requiring special machines. For instance, typical production of the latest NRM Model 60 2½" Extruder, in either resistance or *Induction Heated* Models, is 180 to 200 lbs/hr at 150 r.p.m. with 25 h.p. drive. Larger extruders give correspondingly higher production, as shown in this table:

	Screw RPM	Nominal Lbs./Hr.	HP Based on 7.5#/HP./Hr
3½"	106	350/375	50
4¼"	98	550/600	75
6"	72	1000/1200	150

We'd like to give you detailed facts on *why* NRM Extruders give you "tomorrow's engineering — and performance — today!" High screw speeds are part of the answer, but there are many more . . . all contributing to greater profit on extrusion. We'll be happy to discuss your extruder requirements and recommend the right type and size NRM equipment to do your work most efficiently. Contact us today.

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THE MARK OF QUALITY

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Wheelco Instruments

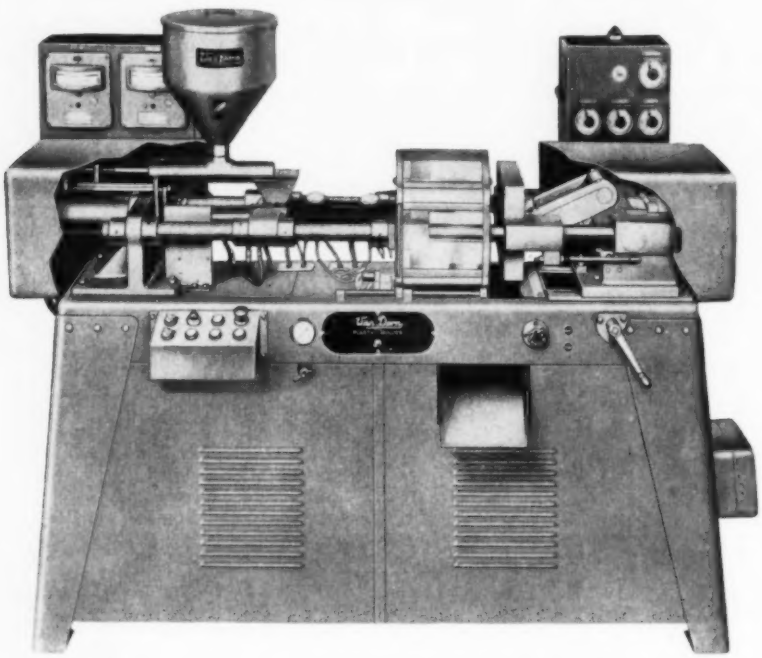
Wheelco temperature controls permit faster, more precise molding

Up to 720 molding cycles per hour on this Van Dorn machine — that's a production rate to put a burden on any temperature controller. What's the instrumentation specified? Wheelco 290 Series proportioning-type Capacitrols are selected to do the job.

A high-capacity heating chamber permits the machine to plasticize material at more than 30 pounds per hour, molding pieces up to 2½ ounces. Large platens accommodate 9" x 12" molds. Completely automatic operation and the larger, circular hopper with pilot light, permit operator to handle more than one machine.

Once again Wheelco is the choice of both the machine builder and user because both recognize the fact that all instrumentation just isn't the same. Experience with molding every type of material, trouble-free operation, and an unmatched field organization are some of the "extras" that win and keep friends for Wheelco.

Instrumentation training for your instrument technicians and supervisors conducted by specially qualified Wheelco instrument engineers is another service offered to the plastics industry. Your nearby Wheelco field engineer will be happy to supply more information.



Horizontal plastics injection molding press built by Van Dorn Iron Works Company, Cleveland, plasticizes at more than 30 lb per hour. Two Wheelco 290 Series Capacitrols maintain precise temperature control, aid fast cycling.

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TYPICAL PHYSICAL PROPERTIES OF FORTICEL

Flow temperature: (°C.) (A.S.T.M.)	D569-48	145—183
Specific gravity	D176-42T	1.18—1.24
Tensile properties:		
Break (p.s.i.)	D638-52T	1900—5900
Elongation (%)	D638-52T	48—63
Flexural properties:		
Flexural strength (p.s.i. at break)	D790-49T	3300—10700
Rockwell hardness: (R scale)	D785-51	+15 to 106
Izod impact: (ft. lb./in. notch)	D256-43T	1.2—11.0
Heat distortion: (°C.)	D648-45T	51—70
Water absorption:		
% sol. lost	D570-42	0.00—0.08
% moisture gain	D570-42	1.5—1.8
% water absorption	D570-42	1.6—2.0

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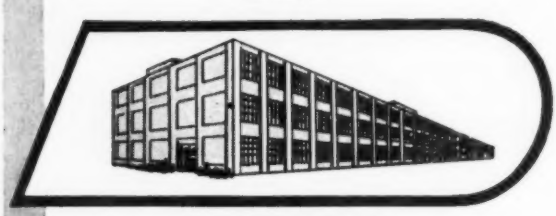

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DOW | **Plastiatrics**

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

PROPER CLASSIFICATION AND USE OF DATA VITAL TO SUCCESSFUL PLASTICS PERFORMANCE

FIVE BASIC DATA TYPES DEFINED

Proper classification and use of available data is one of the most important steps in developing good plastics design and engineering data. Vast differences in the five data types as defined by Dow Technical Service engineers (see chart at bottom of page) make it imperative that care be taken to insure their correct application.

For example, identity data are normally of no value in screening, quality control, engineering or design. At the same time, quality control data should not be applied where design or engineering data are required by the problem being studied.

Generally speaking, quality control, screening and identity data fuse together into the area of *routine testing*. They are characterized by the need for speed and reliability and are often based upon test methods far removed from basic design and engineering.

Engineering and design data, on the other hand, are generally more expensive, time consuming, fundamental and of broader applicability than any other forms of data. They should not be considered in the area of routine testing, but as representing *materials engineering* in its fundamental form.

Successful research, development, production and application of new materials can be greatly hindered by the unwitting transfer of data or methods from testing into materials engineering. And yet, examples of misapplied data have occurred with enough frequency to indicate a potentially serious trouble spot in the industry.

To help combat this problem, technical service engineers at Dow are compiling comprehensive design engineering data and principles tailored for the design engineer. This data, the result of continuing studies which Dow conducts in the interests of the plastics industry, should clarify many areas of possible confusion on the use of plastics data. Future Plastiatrics articles will present this data as it is developed. THE DOW CHEMICAL COMPANY, Midland, Mich., Plastics Sales Department 2100DT3.

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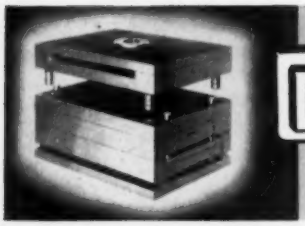
STYRON 330 (Easy Flow—Translucent)
STYRON 777

HIGH IMPACT
STYRON 475
STYRON 440 (Heat Resistant)
STYRON 440M (Easy Flow)
STYRON 480 (Extra-High Impact)

HEAT RESISTANT
STYRON 683
STYRON 700

TYPE OF DATA	DEFINITION	EXAMPLE
DESIGN	Those data on materials which permit the design of a new item or improved design of an existing item through proper choice among materials and calculations of the size and shapes required for satisfactory performance.	The tensile strength of specimens made from a given material as a function of time, temperature and environment.
ENGINEERING	Any data relating to the intended performance of a complete item or portion of that item irrespective of the materials from which it was made.	The bursting strength of a pipe as a function of time, temperature, and environment.
QUALITY CONTROL	Any form of test data relating to predetermined levels of acceptable quality to manufacturing conditions.	The melt viscosity of a plastic under specific and prescribed test conditions.
SCREENING	Those data which rank similar products or materials in order of preference for a given characteristic regardless of specific end-use requirements.	The ranking by density of expanded plastics.
IDENTITY	Results of tests which establish the identity, grade, type, purity or composition of a product among otherwise similar products.	The detection of chlorine in polyvinylchloride (PVC).



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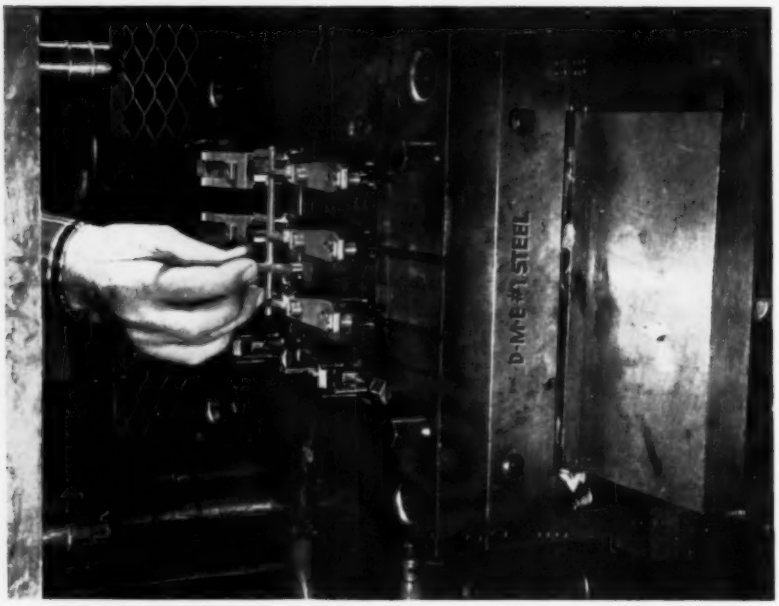

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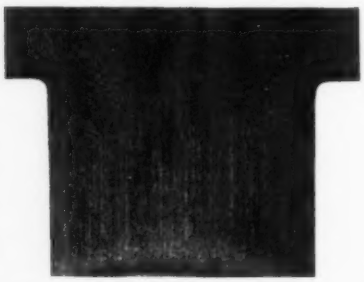

This cross-sectional photo-micrograph of the hot-forged head on a D-M-E Standard Ejector Pin reveals superior grain flow.

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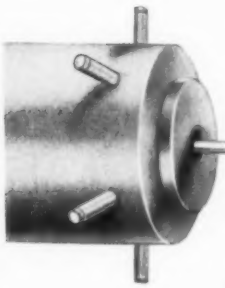

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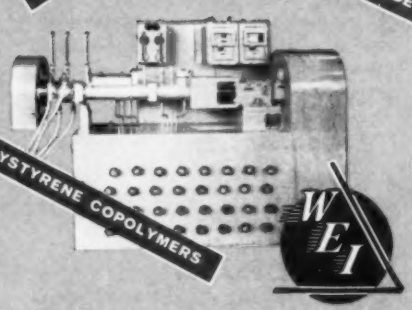

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

Low-Density Cellular Vinyl By Post-Expansion Methods

How conventional vinyl extrusion and calendering equipment can be used to make products by either pre-expansion or expansion-in-place

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Development Center, Avon Lake, O.

THE production of cellular vinyl has been confined for the most part to: (1). atmospherically expanded foams from plastisols (fluid dispersions of vinyl); and (2). pressure expanded unicellular sponge.

The cellular materials atmospherically expanded from plastisols are open-cell products. The rheological considerations associated with this process impose rather severe compound limitations on the material and on the rate of production. On the other hand, the unicellular sponge is a closed-cell material produced with high-pressure capacity presses. This process results in a product which evidences a high shrinkage due to the creation of stresses. In addition, the equipment requirments limit number of manufacturers.

It is apparent, therefore, that current processes for producing cellular vinyl have not only limited the type of products available, but also the number of manufacturers.

During the relatively intensive development of these two processes, the cellular vinyl industry seemingly has ignored the large production capacity of the calendering and extrusion fields. These two industries, together, are responsible for by far the major portion of all vinyl products.

To date, only a few cellular vinyl-nitrile rubber blends have been produced by either extrusion or calendering, and these products are based largely on the curing of the nitrile portion in order to obtain a dimensionally-stable product. In this case, the development has evolved from sponge rubber technology and with rubber-processing equipment.

In order to utilize the large existing vinyl production capacity to produce cellular vinyl materials, a technique has been developed which can be applied to both extrusion and calendering processes. Products produced with this technique fall in the density range from 7-40 pounds per cubic foot.

In Figure 1 it can be seen that the product area defined by these densities extends from the very low density foams to the semi-solid, extruded, high-density cellular vinyl. For the purposes of this article, this area will be referred to as low-density cellular vinyl.

The technique for producing low-density cellular vinyl is based on the incorporation of specific blowing agents (gas-producing chemicals) into normal vinyl compounds which then can be processed onto a supporting medium without activating the blowing agent. These compounds subsequently are expanded by the external application of heat.

Experimental Details

Compound

While a great variety of cellular vinyl compounds ranging from very rigid materials to soft, pliable products have been produced with this technique, only one basic compound will be used to demonstrate it in both the extrusion and calendering processes (see Table 1).

The only variance in the extrusion and calendering formulations involves the stabilization and lubrication systems. In order to limit the experimental variables, proven stabilizing and lubricating systems for each process were employed.

Blowing Agents

The proper choice of blowing agent perhaps is the most important factor in the successful production of cellular vinyl by this technique. It is essential that an agent be chosen that will not liberate gas at the temperature necessary for processing, yet can readily be activated by heat below the melt temperature of the compound. The melt temperature is defined as the temperature at which a vinyl compound will flow under atmospheric pressures.

Although blowing agents with a wide range of decomposition temperatures are available, those specifically applied to this process are shown in Table 2.

While the structure of these materials differ, the choice of blowing agent is determined by the temperature at which it will decompose. The decomposition temperature of a blowing agent normally is reported on the basis of its activation in air. It should be noted that these agents can be activated at lower temperatures by the presence of a variety of materials, including vinyl chloride resin, plasticizer, and other compounding ingredients. The observed decomposition temperatures of the two blowing agents in normal vinyl compounds also are given in Table 2.

Most of the equipment used in the preparation of a compound for extrusion or calendering create areas known as "hot spots." These are areas within the fluxing compound which evidence abnormally high temperatures due to localized high-pressure zones. In order to avoid premature activation of the blowing agent during this preparation and processing, it is advisable to process at a stock temperature at least 30-40° F. below the rated activation temperature of the blowing agent in the compound. This temperature differential will provide a safety zone that normally will eliminate the possibility of premature activation.

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Robert J. Meyer was born in Milwaukee, Wisc., in 1921. He graduated from the University of Illinois in 1943 with a B.S. in Chemical Engineering. He then joined U. S. Rubber Co., and worked at the company's GR-S rubber plant in Institute, W. Va., during 1943-47; and at the Koylon foam production and development installation in Mishawaka, Ind., from 1947-50. He joined Goodrich Chemical in 1950 as Senior Development Engineer in the firm's Institute, W. Va., GR-S rubber plant. In 1952, he transferred to Goodrich Chemical's Avon Lake, O., development center in the Products Application Lab as Senior Development Engineer. Mr. & Mrs. Meyer have two children (both boys), and reside in Lorain, O.

It also has been found that dispersing the blowing agent in plasticizer prior to its addition to the compound will result in a product with a lower density, smaller and more uniform cells, and a smoother surface. Ink-milled dispersions, 50% in plasticizer, usually were employed.

Compound Preparation

The ingredients for both extrusion and calendering were fluxed on a two-roll mill for 12 minutes at a stock temperature of about 270° F. This temperature will vary depending on the compound used, but for these

Table 1. Experimental Compounds.

Ingredients		Formulations, Phr., For	
Chemical Type	Material	Extrusion	Calendering
PVC resin	Geon 101, EP	100	100
Plasticizer	GP-261-dioctylphthalate	40	40
"	Butyl benzyl phthalate	20	20
Stabilizer	Basic lead silicate sulfate	10	—
"	Modified epoxy resin	—	1.5
"	Barium-cadmium laurate	—	1.5
Lubricant	Paraffin wax	0.5	—
"	Barium stearate	—	0.5
"	Stearic acid	—	0.5
Blowing Agent	Azodicarbonamide*	5	8

*Dry weight. Added as a dispersion (ink milled), 50% in GP-261.

formulations and the equipment employed, 270° F. is optimum.

Extrusion

After all the ingredients were banded on the mill, the compound was stripped off, cooled, and cubed or granulated. The compound, in this form, either may be stored or fed directly into the hopper of an extruder. If desirable, the compound may be strip-fed into the extruder either after cooling or directly off the mill.

The compound then was extruded (see Figure 2) onto a supporting core by means of a crosshead. This core carried the unexpanded compound through an oven where it was subjected to heat sufficient to activate the blowing agent and expand the compound.

After leaving the expansion oven, the compound was cooled by passage through a water bath. The cooled compound was taken up on a reel or other take-up equipment. If it is not desirable to expand the compound directly after extrusion, it may be cooled and stored for expansion at some future date.

Extruder

Although the extruder used in the investigation was a 1½-inch model, most plastic extruders with adequate heating control and a crosshead can be employed.

Extrusion conditions were as follows:

Barrel temperature, °F.: Zone 1	260
Zone 2	270
Head temperature, °F.	250
Die temperature, °F.	240
Stock temperature, °F	285
Screw speed, rpm.	6
Core speed, feet per minute	10

Low compression screw (1.32:1 compression ratio, 15:1 length/diameter ratio, and decreasing depth and pitch) was used. A screen pack consisting of a 60- and a 40-mesh screen provided sufficient mechanical working at the extrusion temperatures to flux and form the compound.

Under these conditions a stock temperature of 285° F. was suitable for the extrusion of this compound in an unexpanded state. (See section on Blowing Agents).

Table 2. Commercial Blowing Agents

	Azodicarbonamide	P-P'-Oxy-bis-(benzene sulfonyl-hydrazide)
Decomposition temperature, °F:		
In air	385	310
In normal vinyl compounds	350	300
Cost per pound	$1.95	$1.95

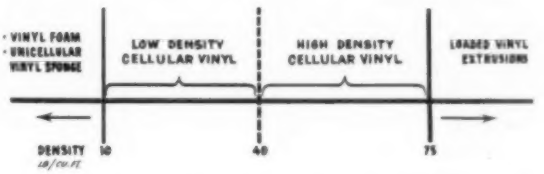

Fig. 1. Density spectrum of vinyl products.

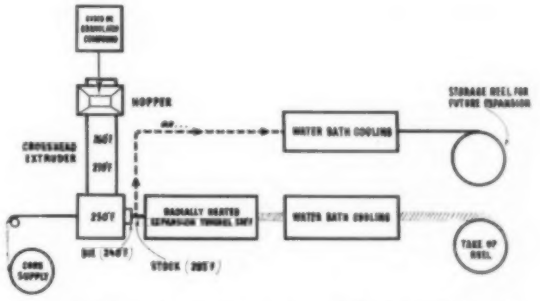

Fig. 2. Schematic flow-sheet for low-density cellular vinyl extrusion.

Core Material

Since vinyl is thermoplastic, the core serves to support the expanding compound during its passage through the expansion oven. For this reason, it is im-

Table 3. Foam Density vs. Temperature and Time of Expansion*

Temperature, °F:	300	350	375	400
Expansion Time, Minutes	Density, Lbs./Cubic Foot			
1	83	83	83	83
3	83	79	47	40
5	83	70	18	Melted
7	83	19	15	Melted
9	83	15	15	Melted

*0.062 in. thick samples (at room temperature) expanded in a hot-air oven.

perative that the core be dimensionally stable at the temperature of the expansion oven. Materials such as cotton string, copper wire, and nylon cord have been employed successfully.

The choice of core material will depend on the end-product use. In some applications it may be desirable to leave the core (such as wire) in the cellular product to obtain a reinforcing effect or to provide a means of fastening. If a soft, pliable material is the desired product, a cotton-string core can be used. Both the nylon cord and the copper wire can be removed since the compound does not adhere to either, but a cotton core generally will be bound into the structure.

Expansion Oven

The oven used to expand the compound was constructed from nine feet of three-inch steel pipe, wrapped with insulated nichrome wire and conveyed with one-inch of insulation. This tubular oven was vented by a line of ¼-inch holes, two-inches apart along the top surface. This method of venting allows the gas to escape and provides relatively uniform heating conditions for expanding the compound.

The expansion cycle for any vinyl compound is dependent on both time and temperature. The activation temperature of the blowing agent will determine the minimum temperature applicable. In Table 3, this relationship was studied.

As can be seen, temperatures below 350° F. fail to activate the blowing agent. Above 350° F. the time necessary to expand the compound decreases as the temperature increases. At 400° F., however, the compound tends to melt before expansion can be completed. The melt temperature will vary inversely with the thermoplasticity of the compound.

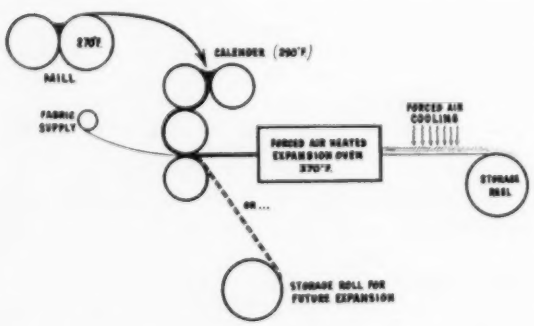

Fig. 3. Schematic flow-sheet for cellular vinyl by calendering.

Most methods heat the outer surface of a material, which conducts heat to the interior. Similarly, a compound containing blowing agent expands first at the surface. However, as the compound expands, it tends to insulate the unexpanded compound. Therefore, a longer cycle is required to heat an expanding compound than is needed by a solid compound of comparable thickness.

An air temperature of 370° F. within the tunnel heater was found to be optimum for expansion of the standard compound.

RF (radio-frequency) heating involves a unique concept. Instead of heating from the outside of a section towards its interior, it heats from the inside out; that is, it concentrates the heat on the interior of a section, and the heat graduates in temperature toward the surface. To date, only a very limited amount of study has been devoted to the expansion of vinyl compounds containing blowing agents with this type of heating. Nevertheless, the initial results seem to indicate that RF heating in conjunction with a hot-air system may overcome the insulating effect of the expanding vinyl compound.

Cooling & Take-Up

In order to prevent distortion, it is important that the expanded material be completely cool before take-up. The temperature of the cooling water will be determined by the length of the water bath trough, the thickness of the product, and the production rate. Other types of cooling, such as forced-air, may be employed if desirable.

Since this method requires a driving force on the core, take-up equipment is necessary in order to maintain a constant tension and speed on the core as it passes through the crosshead, expansion oven, and cooling bath. A capstan device, such as is used on conventional wire take-up equipment, has been found suitable.

Storage & Future Expansion

In many instances, it may not be desirable to expand the compound directly after extrusion. The compound can be stored and expanded at some future time. A slightly-longer expansion cycle will be necessary, since

the material will have to be heated from room temperature instead of extrusion temperatures. Preheating the extrusion to a temperature slightly below that of expansion will result in an expansion cycle comparable to that used in the direct-expansion method.

Compounds containing a blowing agent have been expanded after several months of storage without an apparent loss in gas-producing capability. During this storage period, the material was kept at room temperature out of direct sunlight.

Calendering

As shown in Figure 3, the compound was transferred immediately to a calender after milling, and calendered to the desired thickness. The compound usually was coated onto a supporting fabric which was passed between the bottom rolls of the calender.

On emerging, the unexpanded compound was passed through a forced hot-air expansion oven to activate the blowing agent. The expanded sheet then was cooled by forced air and taken up.

As is the case with the extruded material, the calendered compound may be cooled and taken up without expanding. This material, too, may be expanded at some future time.

Calender

Since the only requirement for the calender is adequate temperature control, most plastics calenders can be used without any modification. The calender we employed in this investigation was an inverted-L type.

The calender is used to laminate the unexpanded compound to a supporting fabric at a specific thickness without activating the blowing agent. Since the standard compound did not show an appreciable temperature rise during calendering, a temperature of 290° F. was used.

Supporting Fabric

In this process, the supporting fabric serves two important functions:

(1). As in the case of the core in the extrusion process, the supporting fabric adds the necessary support and dimensional stability to the thermoplastic compound during the expansion step; and

(2). As a vinyl compound is processed on a calender, stress areas normally are created in the stock. This is especially true at the temperatures employed in this cellular vinyl process. These stress areas usually will not show distortion or curling unless the material is reheated to the temperature at which they are created.

As part of the low-density cellular vinyl process, the compound is heated during the expansion cycle to a temperature well in excess of the calendering temperature. As a result, the stresses are relieved and an unacceptable product (curled and distorted) is obtained (see Figure 4). This distortion is magnified in cellular material, in contrast to solid calendered sheeting.

When the unexpanded compound is calender-coated onto a supporting fabric, the resulting cellular material is an acceptable product; flat and distortion-free. An inexpensive, osnaberg-type fabric can be used as the supporting material. It is thin and almost completely undetectable on the compound after expansion. Many other materials, such as supported vinyl sheeting and heavy upholstery materials, have been employed without difficulty. The choice of supporting material will depend on the final application.

In most cases it has been found necessary to use a supporting fabric; however, all compounds are not equally prone to the formation of these stress areas. Some can be expanded to produce an acceptable product without a support. Here, a screen-belting coated with a silicone emulsion (for release) was used in the expansion oven. A conveyor belt fabricated of this screening (100-mesh stainless steel was found suitable) eliminates the possibility of distorted areas due to air entrapment between the material and the belt, and will permit even heating of the compound.

(Continued on page 62)

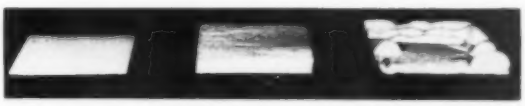

Fig. 4. Cellular vinyl (left) unexpanded, (center) expanded on fabric, and (right) expanded without fabric.

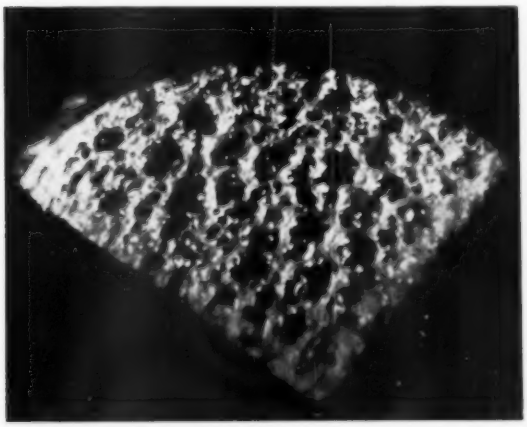

Fig. 5. Photomicrograph of extruded 1-d cellular vinyl (15X).

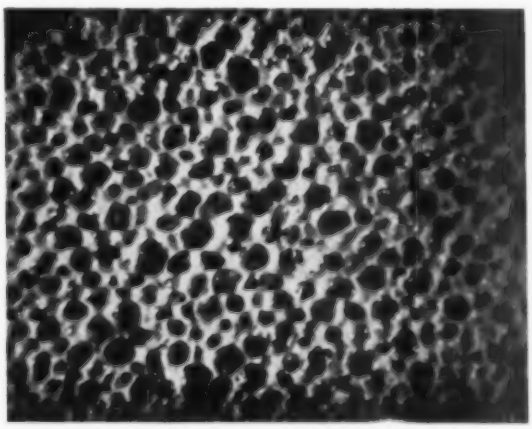

Fig. 6. Photomicrograph of calendered 1-d cellular vinyl (15X).

M. A. SELF, *Pres. (right)*
and
JOHN SCHARNBERG, *Res. & Devel. Engr.*
Logo Div., Bee Chemical Co., (left)
Chicago, Ill.

Coatings for Vacuum Metallizing on Plastics

Current application techniques and formulations for top and base coatings are described, together with the future outlook.

VACUUM metallizing, as used in this discussion refers to the process of depositing a thin, continuous layer of aluminum onto plastic parts by vaporizing the aluminum and condensing it while under a high vacuum. Briefly, the following steps are involved: The plastic parts to be metallized usually are coated first with a resin system. This coating is called the base coat, and is dried so as to be cured and free of volatile solvents. The coated parts are placed in the vacuum chamber and aluminum staples are hung on tungsten wire filaments near the center of the chamber. The filaments are connected to an electrical source, and the pressure within the chamber is reduced to 0.5 microns or below.

The temperature of the filaments is raised to 1,200° F., the point at which the aluminum melts and spreads over the tungsten filaments. Raising the temperature to 1,800° F. evaporates the aluminum, which travels in a radial path from its source, and coats all areas in a direct line with a thin film (see Figures 1 and 2). The parts are removed and given a protective or top coat of lacquer. Metals and alloys other than aluminum may be evaporated and substrates other than plastic often are used; however, discussion in this paper is restricted to these two materials.

The purpose served by the base coat is that of bonding the aluminum layer to the substrate and, in most instances, providing a markedly improved brilliance of plate by affording a smoother surface on which to apply the aluminum.

The second resin coating applied on top of the aluminum to protect the film from wear and the elements is referred to as a top coat for first-surface applications, or as a back-up coat when applied to

second-surface applications where the vacuum plate is viewed through the clear plastic.

The resins in the base coat, top coat, and back-up formulas may consist of single-resin systems; but most generally a mixture of resins is employed to provide necessary properties. Resins used include air-dry or lacquer types which dry through solvent evaporation; baking types, which cure through cross-linking; and air-curing resins which require catalysts. In designing a coating for use in vacuum metallizing, the choice of the solvent system and, more especially, the choice of resin combination has proved to be far more critical than when formulating conventional coatings. Generalizations derived from research data should be approached with caution. The application and formulation problems of the various coatings will be reviewed from a practical aspect, rather than from the less-understood theoretical aspects.

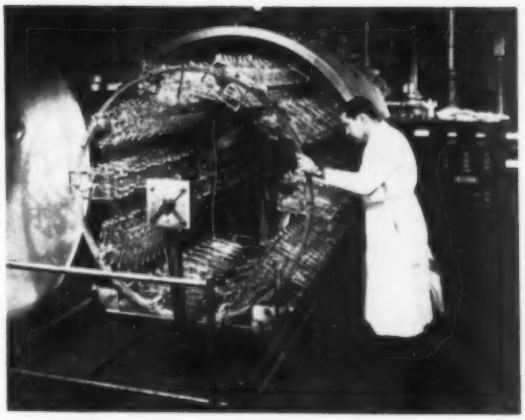

Fig. 1. Production model vacuum-metallizing unit being unloaded after the plating operation. (Courtesy—F. J. Stokes Corp.)

Problems With The Base Coat

Since the base coat is applied first, and since it is the most critical part of the system, problems relating to this coating will be reviewed first.

Adhesion to the Substrate

Adhesion of the base coat to the substrate is essential. The coating does not differ from any quality finish for application to a given plastic.

Adhesion of the Aluminum

Adhesion of the aluminum to the base coat restricts considerably the types of usable resins, since few resins provide good bond. Others neither add nor detract, but many are actually detrimental to the formation of a bond between the aluminum and base coat. Use of low melting resins to allow for a fusion bond at plating temperatures has not proven suitable, since it cannot be depended upon for consistent results. Presumably, this is due to variations in temperatures encountered in the plating bell.

While there has been some head-way, largely through trial and error, in determining types of resins promoting adhesion of the aluminum to the base coat, much work remains to be done before the significant chemical and physical factors involved can be understood.

General Film Properties

General film characteristics, including build, and tendency to orange peel, crater, and hold corners must be controlled carefully. A heavy deposit of the base coat may be required to cover imperfections such as mold polishing marks not noticeable to the human eye until after the part is plated. A thin film of the base coat on such parts would result in a plate lacking brilliance.

The resin film surface should be smooth optically. Orange peel, craters, or pulling from corners to a degree not objectionable in a regular finish, are magnified and can be totally unsatisfactory in a base coat. Correction of these problems is difficult sometimes since the adjustment of a given resin system to overcome orange peel is diametrically opposed to adjust-

Fig. 2. Technician in Bee Chemical Co.'s research laboratories replaces vacuum bell on small vacuum-metallizing unit used to evaluate new coating formulations. (Courtesy — Consolidated Electrodynamics Corp.)

Fig. 3. Vacuum-metallized panels being tested in a unit that can be run alternately as a humidity cabinet and as a salt-spray chamber for accelerated test results.

ments made for craters or pulling away from corners. One involves adding more medium- or slow-drying solvent to induce better leveling, while the second involves removal of the same solvents to provide a given resin system with less flow and more rigidity during drying.

A resin system entirely satisfactory from an adhesion standpoint both to the substrate and to the aluminum, as noted above, may have to be ruled out because of too-low solids at application viscosity. This results in too little build. The adjustments between orange peel, cratering, or pull-away would overlap to such a degree that it becomes impossible to eliminate one problem without creating another.

Iridescence

Iridescence is a term commonly applied to distortion of the plate caused by movement or swelling of the base coat. This condition can be created by applying sufficient temperature, such as to soften the base coat to a point where it moves or flows slightly. A loss of brilliance in the plate results. The condition may occur due to heat in the vacuum-metallizing cycle, in which case the parts will come out dull. Iridescence is not the same as low brilliance due to insufficient build of the base coat, and brilliance-loss often is severe. Parts may be spotty; brilliant in some areas, and dull in areas of distortion.

Cold-flow of resins in the base coat or high baking temperatures in curing a top coat also may cause iridescence. This may occur with such items as automotive ornaments exposed repeatedly to rather high temperatures in warm climates. Distortion due to high-baking temperature of the top coat can be overcome by lowering the baking temperature, if permissible, and often may be eliminated by checking and adjusting the oven to ensure uniform temperatures and eliminate hot spots.

Iridescence also may be caused by alternate swelling and contracting of the base coat. This has been noted particularly in films which absorb relatively substantial amounts of moisture. Frequently, but not always, this type of iridescence is accompanied by a loss in adhesion. A film acting in this manner may represent a highly satisfactory general-purpose finish that will go several hundred hours in a humidity cabinet without visible signs of failure, but which, when plated, most likely will display iridescence in a matter of a few hours in the same test.

Loss of Adhesion

Loss of adhesion to the base by the aluminum on aging is common when using baking systems and, in particular, with catalyzed air-dry or low-temperature cure systems that may cure further over an extended period of time. This seems understandable since a polymer may exist at one stage of cure which provides good adhesion, whereas a higher polymer or a further-reacted resin combination may reduce active groups instrumental in promoting adhesion. An accelerated heat aging test at 140-150° F. over a two-week period has proved to be a satisfactory method of screening materials of this type which have been evaluated thus far.

Exposure in the humidity cabinet results in loss of adhesion between aluminum and base coat, or between top coat and aluminum, as measured by the Scotch tape test. So much so, in fact, that companies using vacuum metallizing have had to limit this test in their specifications.

The loss of adhesion in the humidity cabinet frequently is not sufficient to result in film removal except by use of severe tests (such as Scotch tape) so that the appearance of parts often remains satisfactory. For quality applications, the desirability of meeting this requirement cannot be denied, and systems meeting this test for certain plastics are now in production. Finishes for first-surface metallizing on acrylic plastic, that meet this test, are available and are in use on such items as the speedometer bezels in some current model automobiles.

Outgassing

Outgassing from the base coat interferes with the uniform deposition of aluminum. It is noted either by voids in the aluminum or by darkened areas. Residual solvents in the base coat certainly will give rise to this problem, and it is advisable to force-dry base coats; even though heating may serve no other function than removal of solvents prior to plating. Drying for 30 minutes at 120-150° F. has proved adequate in most cases, and even shorter periods have been employed with good results.

Volatile plasticizers or resins, resins containing volatile ingredients, or resins that decompose and release volatile matter under the conditions existing during the metallizing cycle will give rise to outgassing. These cannot be employed satisfactorily in formulating a base coat.

Humidity Blush

Humidity blush, as in normal finishing, is a problem. The degree of blush which may be tolerated without a serious haze appearing in the vacuum plate is less than that acceptable in a normal finish.

The serious restrictions placed on resins by virtue of the problems noted above, combined with limitations of solvents that may be used without causing crazing or etching on the thermoplastics, make the problems of formulating for good blush resistance rather difficult. In some cases, the use of humidity-controlled conditions at the point of coating application, for the present, at least, are indicated where desired properties cannot be attained by any available coating system (see Figure 3), except one quite sensitive to blush.

Other problems with the base coat certainly exist, but the points noted above are believed to be most important. With so many requirements, the reaching of an ideal solution obviously is unlikely. Workable materials for use on most plastic substrates have been developed through years of testing and formulating. It is important that the applicator understand the special allowances which sometimes must be made in the use and handling of these materials as compared to regular coatings—if desired properties are to be obtained in production.

Top and Back-Up Coats

Considering the top- and back-up coats, we find a situation more nearly similar to that of any normal finish (i.e., corrosion prevention, leveling of surface, and bonding for the base coat; protection and color for the top coat). As noted, this is a protective coat and must adhere before and after exposure to essential tests, must handle well, must not mar easily, and solvents in this coat must not attack the base coat, or else distortion will occur due to swelling and flow of the base coat. In the case of top coats, it may be important that the film be non-yellowing when exposed outdoors. Another frequent requirement for a clear top coat is that it must be colored by the dip-dye process (dipping in a solvent-dye solution, followed by a water rinse).

In using a baking-type top coat (see Figure 4), it often is necessary to interrupt the baking cycle to dip-dye since the film may become relatively impervious to solvents and dyeing after complete cure. Incorporating the color in the top coat prior to application is an alternate and preferred procedure whenever practical, since it eliminates the dyeing operation and permits the use of more stable colors. This approach is best in spray applications where a more uniform color can be produced because of the more uniform film obtained by spray, as opposed to dip or flow coating.

Coating Methods

Speaking of the plating system as a whole, the significance of good adhesion at each interface both before and after exposure to important tests should not be underestimated. This especially is important when adhering plated plastic parts to steel, such as has been done with second surface-metallized emblems and name-plates. Use of the Scotch tape test over a cross-hatched area serves as an excellent measure for determining system's suitability for attaching with an adhesive. The preferred adhesives for this use are non-solvent types, such as Minnesota Mining & Manufacturing Co.'s adhesive EC-1337 which is catalyzed before use with the company's accelerator EC-1352.

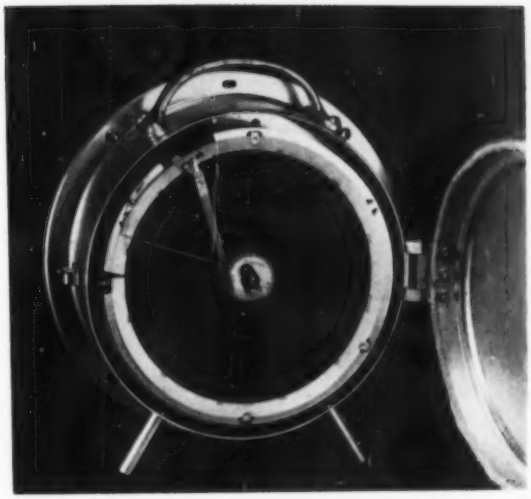

Fig. 4. Temperature recorder is recommended for checking the accuracy of oven temperature control and temperature uniformity during curing of base and top coatings.

Application of base and top coats to first-surface work is accomplished in production by spray-, flow-, and dip-coating techniques, while second surface applications are limited almost entirely to spray application. Spray coating can be accomplished with either siphon or pressure equipment, with some preference given to the latter.

Flow coating involves placing the parts in an enclosed tank (usually on the same spindle going into the plater), rotating the parts, and applying a mist created by forcing the coating liquid under pressure through spray nozzles. No air is employed. The coating material must be sufficiently low in viscosity so that it will atomize at a reasonable pressure. For good results, maximum viscosity is in the range of 30-33 seconds in a No. 1 Zahn cup. After misting, the parts remain in the flow-coating tank and are spun at speeds high enough to remove most of the excess coating. Following this, parts must be rotated slowly until touch-dry if tears and sags are to be avoided.

While this process does require less coating material, the extra operations required and the higher rate of rejects due to unavoidable sags or tears often more than offset its advantages where quality is important. Also, the low application-viscosity needed for flow-coating sometimes necessitates excessive dilution, resulting in a low solids content that, in turn, produces thin films of good build and performance in salt spray or other, more rigorous tests. The flow coating process has been successful especially in the novelty field where low handling cost of many small parts is essential, but where quality control can be somewhat loose.

(Continued on page 54)

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Comparison of Phenolic and Polyester Premix Materials

The two materials have many common properties, but it is their unique properties which are of interest and value to molders

WITHIN a short span of five years, polyester premixes have gained wide industrial acceptance in applications requiring a combination of low cost and high strength. Due to their relative ease of handling and molding and their good physical and electrical properties, these putty-like materials have become one of the fastest growing thermosetting molding compounds in the plastics industry. An indication of this wide acceptance is shown by the 1957 estimated consumption of 20-million pounds by the automotive industry alone.

Polyester materials have taken over applications never before considered for plastic materials. But satisfactory as polyester premixes are, they cannot be expected to satisfy every need. For this reason, and because of the wide acceptance and excellent over-all properties of phenolic molding compounds, phenolic premixes were developed.

Still in the formative stage, phenolic premixes are being prepared by many molders who find them economical and physically satisfactory in specific applications. Thus, molders now have available two low-cost reinforced molding materials with distinct properties.

The following article compares these two premix materials in cost, processing, and properties based on molding of a typical housing part. While true that one example cannot provide a comprehensive and complete comparison, it does offer reliable information to molders for use in selecting the best material for specific applications.

Both polyester and phenolic premix materials are prepared in a kneader or similar type mixer. The term "premix," as it occurs throughout the article refers to reinforced molding compounds manufactured on a molder's premises.

Each premix contains three basic components: a resinous binder, fillers, and reinforcing agents. The principle function of the resinous binder (in any molding material) is to flow and fill-out the mold cavity, as well as to bond the fillers and reinforcement.

Various mineral and cellulosic fillers are used in premixes to lower compound cost. Although they make up the bulk of a molding compound, they do not contribute greatly to the physical properties. Reinforcing agents are directly responsible for many strength characteristics, thus are one of the most important components of a premix. Because of their high cost, they make up the smallest proportion of the three basic ingredients.

Resin Binder

The major difference between the polyester and phenolic premix materials lies in the resinous binder. Since the resin determines the over-all behavior of the molding material, chemical properties of these resins are described in detail.

Polyester Binder

The resinous binder used for polyester premix materials is an unsaturated polyester blended with a reactive monomer such as styrene, vinyl toluene, or diallyl phthalate. To cure this mixture, a catalyst such as benzoyl peroxide is added. Under heat, the monomer reacts rapidly with the polyester to form a cured, thermosetting substance.

Three important characteristics of cure should be kept in mind: (1). Unsaturated resins cure by means of an addition reaction that results in 100% reactive material, with no volatile by-products, (2). Catalyzed polyester resin has limited room-temperature stability, and cures very rapidly under the influence of heat; and (3). Heat initially decreases the viscosity of the polyester resin, and greatly accelerates the rate of the addition reaction.

Phenolic Binder

The resinous binder of the phenolic premix materials generally is a water-soluble, one-step, phenol-formaldehyde condensate of a relatively low molecular weight. (A resin of this type was used in this investigation.) Cure does not require a catalyst, but is dependent upon a time-temperature relationship.

The three main points concerning cure are: (1). Phenolic resins cure by means of a condensation reaction giving off volatile by-products; (2). Phenolic one-step resins have satisfactory room-temperature stability and, under the influence of heat, cure at a slower rate than polyester resins; and (3). During this molding cycle, phenolic resins undergo a smaller decrease in viscosity than do polyester resins.

Fig. 2. Sisal-asbestos filled polyester compound in putty-like form being dumped from kneader mixer.

Processing

The only equipment involved in the preparation of both premixes (see Figure 1) is a kneader or similar-type mixer. The mixing action is similar for both premix preparations, but the phenolic material must be exposed to heat during the mixing cycle for adequate advancement of the material to a suitable molding state. Polyester premix requires no heating and can be molded as soon as it is properly mixed.

Polyester Premix

Weighed amounts of dry filler (clay, limestone, sisal) and lubricants (zinc stearate, calcium stearate, stearic acid) are added to the kneader mixer. After suitable mixing, a pre-blended system of liquid polyester resin-benzoyl peroxide catalyst and color are added and kneaded until a uniform paste results. At this time, glass fibers, if included in the formulation, can be added carefully. Mixing is continued until thorough dispersion is assured and the reinforcement completely

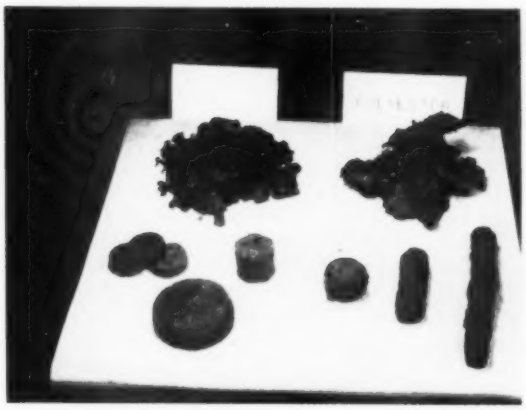

Fig. 1. Types of premix preforms utilized in molding.

Fig. 3. Premix of sisal wood flour-filled phenolic compound is dumped after mixing, showing hard, lumpy form of mixed compound that results.

"wet-out." Upon dumping (see Figure 2) the material is ready for molding. Its limited room temperature stability (1-3 days) necessitates almost immediate use, but shelf-life can be extended by the use of inhibitors and packaging in tightly sealed and lined fiber drums.

Phenolic Premix

The preparation of phenolic premix materials requires a combination of adequate mechanical mixing and, as mentioned before, sufficient heat for chemical advancement of the resin. This operation is performed in a heated mixer which performs three major functions; it dry-blends the ingredients; mixes the resin and dry ingredients into a homogenous mass; and advances the cure of the resin to a state suitable for molding.

The dry ingredients (calcium carbonate, clay, wood flour, sisal, lubricant, and color) are added to a heated mixer and blended until a uniform mix is obtained. The liquid phenolic resin then is added, and the time of resin addition noted. Mixing is continued for a predetermined time to ensure satisfactory advancement of the resin.

Approximately 10 minutes prior to the predetermined dump-time, glass-fibers (if used in the formulation) are added. Dump-time (see Figure 3) is predetermined and dependent upon resin cure, mixing temperature, and formulation. When dumped, the material is suitable for molding. Depending on formulation, the premix form will vary from fine, hard granules to large, hard lumps. The material has unlimited stability, and no special packaging precautions are required.

Molding

Polyester Molding

Prior to molding, reinforced polyester material usually is preformed by hand, or extruded into ropeform (see Figure 1). Molding pressures of 500-1,000 psi. usually are employed at temperatures from 275-300° F. Upon exposure to heat, the mix becomes very fluid, enabling it to flow and fill-out the mold under very low pressures. This high fluidity causes the resin to flow away from the other components of the mix which can result in weld and knit lines found in reinforced polyester parts. This fluidity can be kept to a minimum, and more uniform flow can be obtained by the proper selection of high-absorbing fillers and higher-viscosity resins.

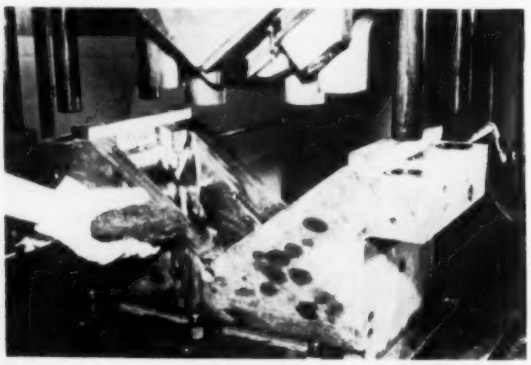

Fig. 4. Preforms prepared by hand from the selected polyester premix material being loaded into the two-cavity housing mold.

Another factor to consider in utilizing these fluid materials is mold design. Proper mold clearance is required to permit the necessary build-up of back-pressure, and to avoid the loss of material through excess flash. Insufficient back-pressure can result in pinholes and voids. Polyester resins are quick-curing. When exposed to heat, the addition reaction of this material rapidly converts the putty-like molding compound into an infusible, thermosetting solid.

Phenolic Molding

The hard, granular form of the phenolic premix material lends itself readily to pressure preforming. Preforms of various sizes, such as small pellets and large briquettes, can be formed at pressures above 5,000 psi. These preforms usually are preheated and loaded directly into the mold (see Figure 4).

Phenolic premix materials generally require molding pressures in excess of 1,500 psi., and temperatures ranging from 325-370° F. High molding pressures are required, because the phenolic resin has a high viscosity prior to cure. This characteristic allows for the uniform flow of the formulated components, reducing the tendency to develop weld or knit lines. Mold designers are allowed greater freedom in phenolic part design, and pins and holes may be molded directly into a part, thus avoiding the need for heavy flash removal and expensive drilling operations.

Phenolic premix materials take approximately 25% longer to cure than do polyester materials, due to the slower rate of cross-linking in the condensation reaction of phenolic resins as compared to the addition reaction of the polyester. With proper preheating, the cure time of the phenolic can be shortened somewhat. Phenolic premixes possess excellent hot strength which prevents warping or distortion of parts as they are removed from the mold. This hot strength also minimizes the use of cooling jigs.

Formulations

In order best to compare phenolic and polyester premix materials, compounds prepared from each resin were formulated to obtain specific physical properties at the lowest possible cost.

We must remember that the formulating of compounds for specific properties may result in a sacrifice of other properties. For example, sisal contributes to high impact, but degrades the electrical properties. Since each application demands certain requirements of a molding compound, a given application must be evaluated in its own right. No one material exhibits all of the properties necessary for all applications, therefore necessary properties must be incorporated in the molding compound by selection of the proper components. It is necessary to determine which properties are of prime importance, and then select the resin, fillers, and reinforcement to meet these requirements.

Properties selected as a basis for comparing the phenolic and polyester premix materials are as follows:

Possible use . . . Housing and similar applications

Impact strength, Izod, minimum ..... 1.5 Ft.-lbs./ 1 inch of notch

Flexural strength, minimum ..... 7,000 psi.

Cost per cubic inch ..... Minimum

The cost per cubic inch value of a molded part is one of the major factors influencing the choice of any molding material. This value depends on the compound's molded specific gravity, as well as on its raw material cost.

The two premix formulations selected as a basis for comparing the phenolic and polyester resins are listed in Table 1, and terminated a planned investigation of the numerous formulating possibilities sought in an efforts to meet the established physical properties and cost requirements.

Economics

An over-all cost analysis of the phenolic and polyester premix materials is given in Table 2. The final unit costs calculated to produce a housing 130 square inches in area are approximate. Many cost factors, such as overhead, power requirement, building and storage facilities, and depreciation are not included. Cost figures for these premix housings are a starting point towards computation of final cost of a given part and, more important, serve as a basis for comparing the two premix compounds.

The economics of a housing part molded from both premix materials were investigated, with total production of 200,000 housing parts selected as the basis for calculation. A two-cavity mold was used in the required presses (100- and 250-ton capacities for polyester and phenolic, respectively) to obtain cost figures.

RAW MATERIAL COST. Unit material cost was based on the premix material cost and the weight per part. Although the two materials differ slightly with respect to material cost, their specific gravities (weight per part) differ greatly. As a result, a unit material cost difference of $0.056 per housing in favor of the phenolic is obtained.

MOLDING COMPOUND PREPARATION COST. To obtain a satisfactory molded part, 1.21 pounds of phenolic and 1.50 pounds of polyester premix materials were required. Because of the difference in weight of the phenolic and polyester housings and the difference in cycle time, which determines the number of parts produced per day, it was found that 242,000 pounds of phenolic material and 300,000 pounds of polyester were needed to produce 200,000 housing parts. It was estimated that a 200-gallon kneader mixer would have sufficient capacity to produce both materials. Based on the different specific gravity values, one run per hour produces 400 pounds of phenolic premix or 490 pounds of polyester premix. The total labor cost utilizing a kneader mixer, was approximated at $3,630 for the phenolic and $3,670 for the polyester. The unit compound cost was the same for both materials.

MOLDING COST. Mold-cycle times for production of both a phenolic and polyester housing were established by molding the specially formulated materials (shown in Table 1) in a two-cavity mold mounted in a single hydraulic press. Cure times and handling times were determined. After an accurate cycle-time per part (60 seconds for phenolic housing; 45 seconds for polyester housing) was obtained, the number of parts that could be produced per day was calculated and the length of time required to produce 200,000 parts determined. It was estimated that three men would be required to handle the molding and finishing operations. By assuming a daily labor cost of $144.00 (three men, 24 hours, at $2.00/man-hr.) and the total number of parts that could be produced per day (1,080 phenolic parts and 1,330 polyester parts), a unit molding cost of $0.133 was calculated for the phenolic housing and $0.108 for the polyester housing.

EQUIPMENT COST. The same type of equipment was used for the production of phenolic and polyester parts, but the phenolic material required a minimum molding pressure of 1,700 psi., whereas the polyester could be molded at 700 psi. This difference in mold pressure requirements necessitated the use of a 250-ton press for phenolic, as compared to a 100-ton press for polyester for the molding of two housing parts, each having a projected area of approximately 130 square inches. To preform both materials satisfactorily, an extruder with automatic cut-off for proper weight determination was used for the polyester, and a 75-ton performing press for the phenolic. The equipment selected had a capacity greater than that required to give the proper amount of

Table 1. Premix Formulations and Resin Properties.

Components, phr.:

	Phenolic	Polyester
Resin	40.00	33.00
Sisal (¼-inch fiber)	15.00	11.00
Wood flour	27.75	—
Asbestos floats	—	53.09
"Silvacon"	9.00	—
Calcium carbonate	5.00	—
Zinc stearate	1.25	1.25
Lime	1.00	—
Black pigment	1.00	1.00
Benzoyl peroxide (50% solids)	—	0.66

Resin properties:

	Resin A-163*	Resin 9520‡
Viscosity at 25° C., cps.	2,000	2,500
Specific gravity at 25° C.	1.25	1.09
Methanol solids, %	75.0	—
Free formaldehyde, %	0.8	—
% Polymerizable	—	100
Color, APHA, max.	—	150
Stability: At 23° F., months	3	—
Uncatalyzed, in dark at 70° F., months	—	4
Catalyzed (2% benzoyl peroxide paste), in dark at 70° F., days	—	4
Dilutability, :1	1.75	—
Ash content, %	1.57	—
Gel time**, secs.	—	209
Peak exotherm**, °F.	—	394
Time at 150° F. to peak exotherm, secs.	—	278
Stroke cure time at 150° C., secs.	55.0	—
Set time at 135° C., secs.	490.0	—
pH	7.6	—

*Plaskon Phenolic Premix Resin A-163.
‡Plaskon Polyester Resin 9520.
**SPI Gel Time test, 1% benzoyl peroxide, 180° F. bath.

Table 2. Economics of Premix Materials*

	Phenolic Premix Material	Polyester Premix Material
Raw Material Cost:		
Weight of part, lbs.	1.21	1.50
Specific gravity	1.38	1.71
Material cost/lb.	$0.154	$0.161
Unit material cost	$0.186	$0.242
Molding Compound Preparation Cost:		
Total molding compound required lbs.	242,000	300,000
No. of runs in 200-gal. mixer to produce molding compound (estimating 400 lbs. of phenolic and +90 lbs. of polyester/run)	605	612
Labor cost to make compound at 1 hr./run (3 men per run @ $2.00/man-hr.)	$3,630	$3,670
Unit compound preparation cost	$0.018	$0.018
Molding Cost:		
Cure time, secs.	60	45
Handling time, secs.	20	20
Total mold time, secs.	80	65
Parts produced per hour	45	55.4
Per 24-hour day	1,080	1,330
Time required to produce 200,000 parts, days	185	150
Labor & finishing cost	$26,600	$21,600
Unit molding cost	$ 0.133	$ 0.108
Equipment Cost:		
Mold, two-cavity	$15,000	$15,000
Press	$22,000#	$16,000##
High-frequency preheater	$ 3,000	——
Preforming apparatus	$10,000	$ 8,000
Kneader mixer (200-gals.)	$24,000	$24,000
Total equipment cost	$74,000	$63,000
10% Depreciation per year	$ 7,400	$ 6,300
Depreciation per day	$ 37.00	$ 31.50
For production days (185 Phenolic, 150 Polyester)	$ 6,850	$ 4,730
Unit Equipment Cost	$ 0.034	$ 0.024
Total Unit Cost (exclusive of power, building, storage, etc.)	$ 0.371	$ 0.392

*Based on production of 200,000 housing parts from a two-cavity mold.
#250-ton press.
##100 ton press.

material, but had the same production rates. In addition, phenolic material must be preheated to obtain its minimum cycle time.

Having obtained the total equipment cost, $74,000 for the phenolic and $63,000 for the polyester, a 10-year amortization at 10% per year was assumed. On the basis of a 200-day year, depreciation for each material per day was determined—$37 for phenolic and $31.50 for polyester. Actually based on the time required to produce 200,000 parts, the yearly working days pro-rate to 185 for the phenolic, 150 for the polyester. The operating depreciations for each material thus were found to be $6,850 annually for the phenolic and $4,730 for the polyester. These depreciation costs were utilized to derive a unit equipment cost resulting in a $0.01 advantage for the polyester material.

Final Unit Cost. The total unit cost of the phenolic-molded part differs from that of the polyester by $0.021 per unit. This cost difference should not be construed as final, but as the result of the comparison bases used in this paper. The economics of each application should be analyzed on its own merit. Only a molder with the knowledge of his individual production facilities can make a true evaluation.

Conclusions

Phenolic resins can be used as binders for reinforced plastics molding materials, and the versatilities and economics inherent in polyester premixes also are available for phenolic premix materials. The molder now has two low-cost molding materials that can be manufactured on his premises. Polyester premix materials, now well established for many applications, have paved the way for the introduction of a new low-cost, thermosetting premix material. Phenolic premix materials, with their unique properties, will extend the scope of use for thermosetting premix compounds.

A comparison of the phenolic and polyester premix materials, as outlined in this paper, indicates that they exhibit many overlapping properties. However, they also possess many properties not common to both. For example, the formulated polyester material exhibited ease of handling, rapid cure cycles, low molding pressure requirements, high flexural and impact strengths, and superior electrical properties.

A very important advantage of the polyester materials, not considered in this paper, is unlimited color. This property alone can determine the selection of one

(Continued on page 61)

Guest Editorial

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Developing the Custom Molding Market

CUSTOM molding is an entirely separate phase of the plastics business. When posed with the question as to where we might expect to find a custom molding market, I must emphatically answer that almost every industry is a potential customer for molded plastics.

A recent issue of "Fortune" magazine published a list of the 500 largest industries in the United States which, totaled together, represented 188-billion dollars in annual sales. In looking this list over, it was found that approximately 20% of the companies included are current users of plastics. There are, of course, a large number of firms in this country, both medium and small, who are also very good prospects for custom molded items. We must not overlook any of these potential customers when trying to develop our market.

Let us consider where can some of these potential markets be found?

Building Construction Components. The building industry, both residential and commercial, has had a tremendous expansion which should continue for many years. Plastics have not been used in this field to any extent, but there is reason to believe that they could be. Working closely with prefab housing manufacturers, mobile home manufacturers, and large project builders, a market could be developed.

Lighting Industry. The lighting industry has just been scratched as far as custom molding is concerned. This field offers tremendous potential in louvers, fixtures, lamp holders, reflectors, etc. for residential, non-residential, and outdoor use.

Home Appliances. This field has been fairly well saturated over the years by custom molders and a number of the larger manufacturers have gone captive, but there still is a tremendous volume available as custom molding.

Office and Commercial Appliances. The office and commercial appliance field offers an opportunity to bring about some startling advantages by the application of plastics. With the introduction of high-impact materials, such items as frames, housings, and carrying cases can be molded more economically than they are now fabricated from other materials.

Communications. A number of items are currently being molded for this very large industry. Radio, TV, telephone, record players, intercommunication systems, etc., offer large volume and should continue to grow.

Transportation. The automotive industry offers large-volume possibilities in most all types of molding. The aircraft industry is interested in the use of plastics for weight reasons.

Food Handling. This is a tremendous field and has not been fully expanded. Containers for packing, shipping, processing, and storage of foods is one phase offering large volume. The handling of foods, dishes, etc., in restaurants and hotels, as well as the handling of foods in various processing operations, is a potential not to be overlooked when trying to develop your market.

Industrial Components. A number of various items such as housings, bearings, gears, dust covers, containers, and machine parts are made, but this field could be expanded a great deal more.

In selecting a specific field of industry on which to

(Continued on page 54)

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Optical Properties of Translucent, Glass-Reinforced Panels

The results of an investigation of sheet made from unsaturated polyester resin containing acrylic monomers.

THIS paper presents the results of an investigation of the optical properties of fiber glass-reinforced translucent sheet fabricated with unsaturated polyester resin containing acrylic monomers, and the effect of such monomers on the wetting and curing properties of the resin.

Since the time acrylic monomers were first used in polyester resins, data has been published showing the resulting improvement in weathering properties. Little or no data is available showing the effects of such monomers on optical properties. During the interim, the industry has recognized that substituting methyl methacrylate for part of the styrene in standard polyester resins generally increases the fiber wetting properties of the liquid resin, and changes the transparency of the sheet. However, other important changes take place.

Upon changing the monomer system, the appearance of the sheet changes, not only in transparency, but also in the color of the light transmitted directly through the sheet and in the color of the haze or shadow area of the sheet. All sheets are affected, whether they are colored or natural and regardless of translucency.

In the following experiment, we will show the effect of acrylic monomers and other variables on the transparency, color, and haze of the reinforced sheet. Also, the effects on the wetting and curing properties of the resin will be shown.

For comparison purposes, Table 1 lists the properties that are under investigation based on a standard styrene-type polyester and a methyl methacrylate-type polyster.

Experimental Considerations

What factors can influence the optical properties of structural sheet?

Among those that can be embodied in the resin are the type of vinyl monomer, the type of acrylic monomer, the ratio of vinyl to acrylic monomers, and the total monomer content. The inhibitor and light-stabilizer used in the resin also could affect the optical properties. Factors that might optically influence the sheet in the manufacturing stage are the catalyst system, the cure cycle and the type of glass reinforcement used.

What optical properties warrant investigation to determine differences in appearance in the variety of sheet that can be manufactured?

Since the reinforced sheet is optically nonhomogeneous because of the possible differences between the refractive indexes of the glass mat, the mat binder and the impregnating polyester, the refractive index of the resin impregnant in the reinforced sheet is important. For the same reason, measurements of the haze properties of the reinforced sheet should be of value. Important haze properties are haze percentage (amount of light scattered to form the haze), color, and color purity (the more strongly colored, the higher the color purity).

Other important optical properties are total light transmittance, and the color and color purity of the transmitted light.

To aid in establishing the whole course of color development, the color of the liquid resins and unreinforced castings also should be determined. The refractive index of the unreinforced castings should be helpful in finding the effects of the type of glass fibers used in the corresponding reinforced sheet.

Other properties of the resins may change. The most important of these are viscosity, wetting properties, and curing properties.

Experimental Design

Nine factors that could be investigated and fourteen tests worth performing are listed in Table 2. To minimize testing and ensure accuracy of data in its interpretation, we chose to investigate the nine factors at two levels, each by statistical methods. By choosing a completely balanced statistical pattern, we can measure the effects of each individual factor at its two levels and any interaction between factors. An interaction is the property of a factor being dependent on another factor.

All of the considerations in choosing the factors and levels are too numerous to list, but we can mention the most important.

The light scattering of a heterogeneous system (the reinforced sheet in this case) is a function of the differences in refractive indexes, the number, and the proportions of the phases in the system. The refractive index of a homogeneous phase (the resin, for example) is a function of the refractive indexes and the amounts of the phase components. Therefore, to investigate the variables to the fullest, we chose to incorporate as many practical materials as possible with different refractive indexes. Thus, we chose vinyl toluene (n_D = 1.5395) and n-butyl methacrylate (n_D = 1.42215) as practical substitutes for styrene (n_D = 1.5439) and methyl methacrylate (n_D = 1.4118). The investigation of these two substitute monomers also enabled us to find the relative effects of small changes in refractive index of one phase upon the optical properties of the heterogeneous system.

The ratio of vinyl to acrylic monomer should exhibit extremes in differences between refractive indexes of the test resins. Monomer content should have only a minor effect on the refractive indexes of the resins under test since the refractive index of the polyester alkyd (n_D = 1.5322) is intermediate and the variation in alkyd content is small.

Optical properties of a system of resins or reinforced sheets might be changed markedly by the inhibitors,

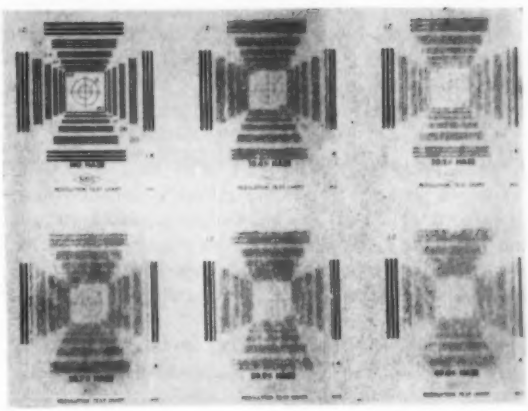


Fig. 1. Effect of haze percentage on resolution chart specimens.

catalyst systems, and cure cycles used.

The second phase of the heterogeneous system is treated glass fibers. A possible third phase is the binder used on commercial glass mat. If the mat binder remains in place as the reinforced sheet is fabricated, it will constitute a pure third phase; if the binder partially dissolves in the impregnating resin but dissolves as a function of some measurable factor of the resin, it will cause a varying but measurable resin phase; if the binder dissolves completely and is fairly uniformly distributed throughout the impregnating resin, there will be no third phase. Therefore, we decided to investigate two identical mats from the same treated fiber and differing only in that one contained a commercially-used binder while the other had no binder at all.

Limitations embodied in the choice of factors and levels are economics, known physical, chemical, and optical properties and, of course, results of preliminary

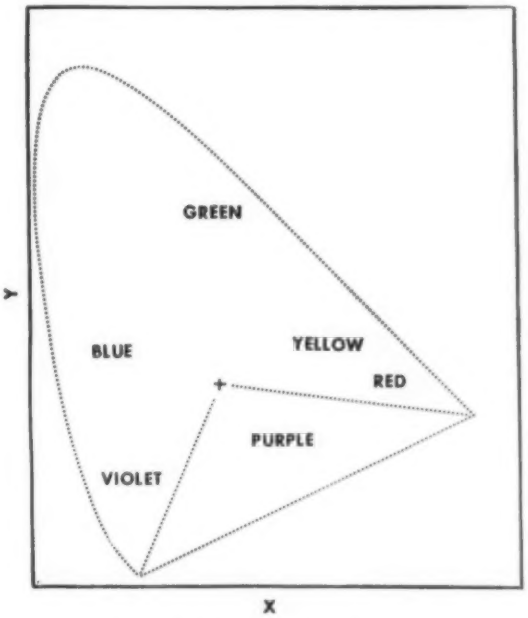


Fig. 2. C. I. E. chromaticity diagram.

testing. For example, we chose to include only one polyester alkyd since it has proved to be the best. A preliminary investigation of different alkyds proved that no other alkyd showed more promise of being more applicable to the type of resins investigated.

Experimental Procedures

The 32 test resins were prepared in the laboratory from commercial materials in an exact manner fitting the statistical method employed to analyze the test results. The resins were catalyzed, vacuum degassed, and molded into reinforced sheets and unreinforced castings. The reinforced sheets were laid up between 300 PT Cellophane, mounted in a stretcher frame, and cured between weighted glass plates. The pressure applied to the surface of the curing sheet was 10 pounds per square foot and the thickness of the sheet was controlled to 0.065 ± 0.005-inch. The calculated volumetric glass content of the sheet was $15 \pm 2.5\%$ with two-ounce glass mat.

Unreinforced castings 0.125 ± 0.010-inch thick were made between glass plates. A rigid time schedule was followed throughout so that such fugitive properties as fiber wetting could be determined.

Haze percentage and total light transmittance were measured using a General Electric Recording Spectrophotometer. In the case of a transmitted light measurement, the spectrophotometric curve was recorded for all the light passing through the sample. In the case of haze measurements, the directly-transmitted beam of light was absorbed by a non-reflecting (black) specimen covering the sample port of the instrument, and the color and amount of light scattered by the reinforced sheet beyond the standard sample area of the instrument were recorded. The characteristic scattering associated with haze percentage can be seen in Figure 1. Specimens with the indicated haze percentages were mounted one inch away from NBS Resolution Charts to show the associated image obscuration.

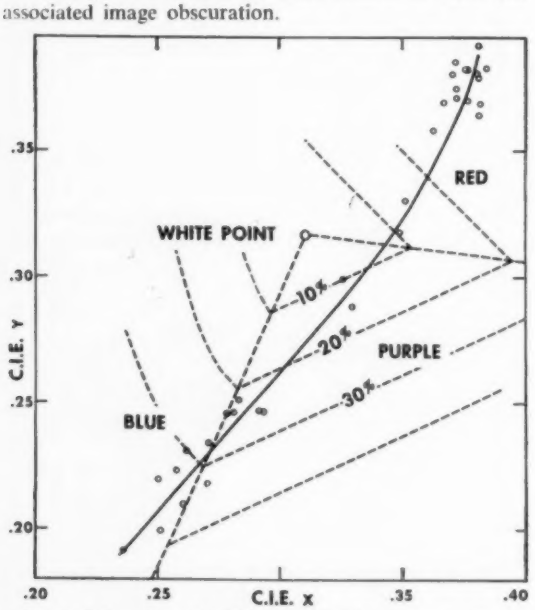


Fig. 3. Enlarged portion of haze chromaticity curve in Fig. 2.

Conventional colorimetric techniques were used to calculate haze color and haze color purity. From the spectrophotometric curves, the chromaticity coordinates were calculated, and from these the color and purity were determined. On the general C.I.E. Chromaticity Diagram, Figure 2, the point marked "x" corresponds to "white." A straight line through this "white" point and any specimen point (Figure 3 shows the specimen points and is an enlarged portion of Figure 2) intercepts the spectrum locus (the closed parabolic curve on Figure 2) at the "dominant wavelength." This intercept indicates the general color of the specimen. The percentage distance from a point representing the specimen to the "white" point (with respect to the distance between the spectrum locus and the "white" point) is the "purity" of the color. Lines of equal percentage purity are drawn on Figure 3.

The range of haze color for the specimens studied fell very close to a straight line and, therefore, it was expedient to analyze the data on the basis of the x-coordinate. This technique was used throughout.

The color and color purity of the total light transmitted were determined by methods analogous to haze color and purity determinations. Barcol Hardness of the unreinforced sheets were measured at room temperature.

Glass fiber wetting properties of the liquid resins were determined by measuring the time for the resin to wet out the glass mat completely. Difficulties were encountered in the measurements as will be discussed later.

Viscosities of the test resins were measured at 77° F. using a Brookfield Viscometer and standard procedure.

Exotherm characteristics of the resins were determined under two conditions. First, exotherm curves were recorded for all resins using 2% benzoyl peroxide paste (50% BPO) as the catalyst and at 180° F. bath temperature. Second, the exotherm curves were recorded using the catalyst system and bath temperature (gel cycle) indicated in Factor F.

The SPI gel times (150-190° F.), cure times (150° F. to peak exotherm), and peak temperatures were taken from the curves for the determinations made using the 180° F. constant temperature bath.

For those exotherm characteristics determined employing a constant bath temperature corresponding to the gel cycle temperature, the cure times from 30° F. below bath temperature to peak exotherm, and the peak temperatures were measured.

Actual gel temperatures were determined by laying off the actual gel time on the exotherm curve (see Figure 4) and determining the temperature of the sample at that time. The samples used in determining gel time were of the same size and shape as those used in determining exotherm characteristics.

By measuring the cure times and actual gel times from a point 30° F. below bath temperature, the times measured were corrected approximately for the 20° F. gel cycle temperature differential and minor variations in resin viscosity and initial temperature.

Experimental Data

Experimental data is shown in Table 3. Here, the differences caused by the factors and levels are listed

in a manner so that the effects of each factor can be determined readily and the optical and cure properties, as well as the viscosity of any of the 512 possible combinations of factors can be calculated.

The first two columns list the average value for each property and the statistically-determined standard deviation in measuring the property. Then, the significant factor contrasts are listed for each factor. These represent numerical changes in property caused by a change in level of the factor. A positive contrast shows that the average value of the property is increased in going from the low level (A_0, B_0, etc.) to the high level (A_1, B_1, etc.). A negative contrast shows the reverse effect.

Calculating the properties of any one combination of factors is done by adding half of the appropriate contrast to the average value of the property. The exceptions are the interactions listed in the foot notes of Table 3. The property values are listed for those factors that exhibit interaction. These values should be substituted for the average value of the property and handled in the same manner, except that the factor contrasts for the interacting factors should be neglected.

Sample calculations of the combinations of factors A_0, B_1, C_1, D_1, E_0, F_1, G_0, H_0, and J_0 for the refractive index, and haze percentage of the reinforced sheet are shown in Table 4.

Other optical properties calculated for this combination of factors (which incidentally is the IC-1027-2 combination, actually measured and listed in Table 1), are:

Transmittance, %	84.4
Transmitted color (CIEx)	0.3130
Transmitted color purity, %	2.6
Dominant wavelength transmitted, mmu	570
Haze color (CIEx)	0.2583
Haze color purity, %	33.8
Color of clear casting (CIEx)	0.3167
Liquid resin (CIEx)	0.3158

Table 1. Comparison of Properties by Actual Measurements

	Standard Styrene-Type Polyester (IC-420-2)	Methyl Methacrylate-Type Polyester (IC-1027-2)
Resin content as supplied, %	75	75
Styrene content added, %	25	25
Viscosity, cps.	300	176
Curing properties at 180° F. with 2% benzoyl peroxide paste (50%):		
Gel time (150-190° F.) min.	3.45	2.75
Cure time (150° F. to Peak) min.	5.67	4.75
Peak temperature, ° F.	412	398
Optical Properties:		
Liquid resin color (C.I.E.x)	0.3183	0.3156
Clear castings color (C.I.E.x)	0.3152	0.3161
Reinforced Sheet:		
Refractive index	1.5583	1.5478
Transmittance, %	81.6	86.9
Transmitted color purity	Trace (1.8%)	Trace (2.5%)
Transmitted color (C.I.E.x)	Yellow (0.3126)	Yellow (0.3134)
Dominant wavelength transmitted mmu	570	569.5
Haze %	76.1	13.4
Haze color purity	Very light (9.7%)	Light (32.2%)
Haze color (C.I.E.x)	Blue (0.2877)	Violet (0.2704)

The exotherm and gel characteristics of the factor combinations are calculated by the same procedure. Since the data was recorded in such a way as to determine the relative effectiveness of the catalyst systems and not their efficiencies, certain corrections must be made to relative values that can be calculated in order to reduce them to actual. These additions or corrections are, as follows:

(1). To the calculated actual gel time and cure time, add 0.9 minutes if the gel cycle is F_0 or 1.0 minute if the gel cycle is F_1. These corrections reduce the calculated data to actual starting conditions (room temperature).

(2). To the gel temperature differential, add the gel cycle temperature F_0 or F_1.

Experimental Results

The most outstanding characteristics of the reinforced sheet are the haze properties. As suspected, there is a close correlation between haze percentage and resin refractive index. The data shows that those factors which are most important in increasing the refractive index of the resin used in reinforced sheet (those approaching the refractive index of the glass $n_D = 1.5536$) also are most important in reducing its haze percentage.

The average refractive index for the resins without glass mat is 1.5465; while the average index with glass mat is somewhat lower at 1.5450. Only a minor part of this decrease is attributable to fibers in the vicinity of the resin body under test. The two significant, de-

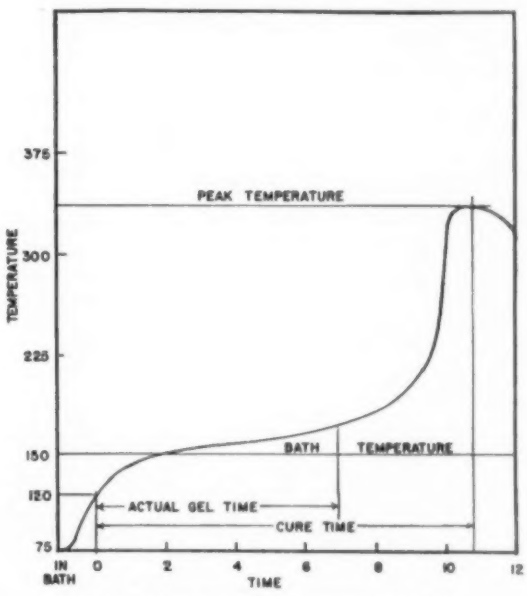


Fig. 4. Exotherm curve of time-temperature effects.

Table 2. Experimental Factors and Levels.

Factors	Levels
A. Vinyl monomers	Styrene (A_0) vs. equal-weight mixture of styrene and vinyl toluene (A_1)
B. Acrylic monomers	Mixture of 75% methyl methacrylate and 25% n-butyl methacrylate by weight (B_0) vs. methyl methacrylate (B_1)
C. Monomer ratio, A:B	1:1 (C_0) vs. 5:3 (C_1) by weight
D. Total monomer content	44% (D_0) vs. 40% (D_1) by weight
E. Inhibitor	E_0 vs. E_1 (E_0 is the inhibitor used in Interchemical's methyl methacrylate-type polyester, while E_1 is the inhibitor used in the company's styrene-type polyester)
F. Catalyst system & gel cycle	1% benzoyl peroxide and gelling the resin for ½-hour at 170° F. (F_0) vs. 0.05% cobalt naphthenate, 0.5% benzoyl peroxide, and 0.5% methyl-ethyl ketone peroxide, 60%, and gelling the resin for ½-hour at 150° F. (F_1)
G. Light stabilizer	G_0 vs. G_1 (both are stabilizers used in Interchemical's polyesters)
H. Cure cycle	½-hour at 220° F. (H_0) vs. one hour at 250° F. (H_1) over and above the gel cycle indicated in Factor J
J. Glass mat	Ferro HSB Uniformat, two-ounce Type F, silane-treated (F_0) vs. a special mat identical to J_0, but containing no binder (J_1)

Table 3. Optical, Physical and Cure Properties Test Results.

	Standard		Significant Factor Contrasts								
	Average	Error	A	B	C	D	E	F	G	H	J
Unreinforced sheet refractive index	1.5465	±.0002	—.0015	.0011	.0047	—.0006	—	—.0006	.0007	—	—
Refractive index	1.5450	±.0002	—.0017	.0004	.0047	—	—	—.0005	.0007	—	—.0004
Haze percentage	28.8	±2.5	6.4	—	—17.6*	—	—	—	—5.1	3.6*	—
Haze color (C.I.E.x)	0.3272	±.0050	0.024**	—	—.093**	—	—	—	—	—	—
Haze purity, %	29.2	±2.5	—5.0***	—	—6.0***	—	—	—	—	—	—
Transmittance, %	84.4	±.4	—	—	—	—	—	—	—	—	—
Color purity of transmitted light, %	2.1	±.1	—	—	0.9	—	—	—	—.5	—.5	—
Dominant wavelength of transmitted light, mmu	568	±.6	—	—	3.0	—	—	—	—	—	—
Liquid resin color (C.I.E.x) one-cm. three-mm. thick	0.3140	±.0002	—	—	0.0005	—	—.0007#	0.0024#	—.0014	0.0006	—
Transmitted color (C.I.E.x)	0.3127	±.0002	—	—	0.0015	—	—	—	—	0.0009	—
Transmitted color (C.I.E.x) after 200 hrs. Fadeometer	0.3145	±.0004	—	—	0.0015	—	—	—.0016	0.0009	—.0010	—
Viscosity, cps.	154.4	±11.2	24.2	—22.2	—	88.0	—	—	—	—	—
Actual gel time, min.	6.74	±0.18	—	—	—1.3##	—	2.4##	—.2##	—	—	—
Gel temp. Differential, °F.	14.2	±0.5	—	—	—	—	—	—	—	—	—
Cure time at gel cycle temperature, min.	11.1	±0.2	—1.0	—	—1.8###	—1.0*	2.2###	3.5###	—	—	—
Peak temperature at gel cycle temperature, °F.	353.3	±2.0	—	9.9	15.1	—	—	61.4	—	—	—
SPI gel time, min.	3.53	±0.10	—	—	—	—	1.29	—	—	—	—
SPI cure time, min.	3.59	±0.10	—.29	—.29	—.14	—.34	—.35	1.28	—	—	—
SPI peak temperature, °F.	393.8	±1.4	—6.7	5.0	12.7	—9.3	5.3	—	—	—	—
Barcol hardness, unreinforced sheet	43.0	±0.4	—	1.4	—	—	—	—	—	—	—

INTERACTIONS:

	C_0	C_1
*H_0	33.7	20.2
H_1	41.5	19.8

	A_0	A_1
**C_0	.3725	.3754
C_1	.2583	.3030

	A_0	A_1
*** C_0	29.9	34.8
C_1	33.8	18.8

	E_0	E_1
#F_0	.3137	.3129
F_1	.3160	.3144

	C_0		C_1	
	E_0	E_1	E_0	E_1
##F_0	5.5	8.8	4.9	8.1
F_1	6.9	8.2	4.8	6.6

	C_0		C_1	
	E_0	E_1	E_0	E_1
###F_0	8.2	11.2	7.1	10.8
F_1	13.6	14.7	10.9	12.0

NOTE: Properties are listed for reinforced sheet unless otherwise noted.

termined factors which could account for more of this difference are n-butyl methacrylate content (in B) and total monomer content (in D). By comparing the sum of the refractive index factor contrasts of B and D for the different combinations of levels, it is apparent that the maximum combined effect of B and D decreases the average refractive index of the unreinforced casting to near that of the reinforced sheet. The effect of the lower monomer content is as important in reducing the difference in refractive index between the two types of sheets investigated as the presence of n-butyl methacrylate.

The haze percentage analysis shows no significant effect on incorporating n-butyl methacrylate, but does show an interaction between monomer ratio (in C) and cure cycle (in H). Increasing the vinyl monomer content within the limit of this investigation decreases the haze. The interaction with the cure cycle shows that for a low styrene content, a gentle cure produces sheet of lower haze than does the vigorous cure. For a high styrene content, a change in cure does not affect haze percentage.

The analysis of haze color indicates that two factors are in control. The haze color is bluest for the factors styrene (A_0) at the 5:3 monomer ratio (C_1) either with or without n-butyl methacrylate. When vinyl toluene (A_1) is used 1:1 (C_0) with the acrylic monomers, the haze color is the reddest. The interaction indicates that for sheets with the redder haze, the presence of vinyl toluene is unimportant; whereas the color of the sheets with low acrylic monomer (C_1) changes from blue to purple as vinyl toluene is added. Intermediate colors can be obtained throughout this range.

The haze color purity is controlled by the same factors as haze color and, again, with an interaction between the two factors. The haze color is the purest at the high acrylic monomer content and the most dilute at low acrylic monomer content when vinyl toluene is present. The effect of acrylic monomer content on haze purity is reversed and greatly reduced when styrene is the only vinyl monomer present.

Transmittance measurements, including the scattered haze, indicate no significant difference between panels and, therefore, no significant factors.

The dominant wavelength of the transmitted light is affected in a minor way by the monomer ratio. Less acrylic monomer makes the color very slightly yellower. The total color shift from the 1:1 to the 5:3 ratio is only three mmu.

The color of the reinforced sheet, as indicated by C.I.E.x, is affected not only by the monomer ratio, but also by the cure cycle. The more vigorous cure increases the yellowness of the sheet slightly.

The development of color as the resins cure into the two types of panels investigated (unreinforced and reinforced) shows some interesting behaviors. Perhaps of even greater interest is the effect of ultra-violet light on the development of color in reinforced sheets exposed for 200 hours in the Fadeometer.

For the range of specimens studies, the liquid resin color is influenced only by the choice of light stabilizer. The IC-1 type (G_1) lends a less yellow color. This advantage persists in the unreinforced castings, but does not show up in the reinforced sheet before exposure. After exposure, the IC-2 (G_0) shows a color advantage. Another color advantage shows up in those clear castings incorporating the IC-420 type inhibitor (E_1) and the benzoyl peroxide catalyst system (F_0). An interaction between these two factors, E and F, occurs to such an extent that castings almost completely free of color can be made using a combination of the IC-420-1 Polyester modified with acrylic monomers and catalyzed with benzoyl peroxide (E_1, F_0, G_1).

The same color advantages exhibited by the unreinforced castings do not carry over into the reinforced sheet. The effects of the inhibitor, catalyst, and light stabilizer drop out entirely. The monomer ratio and the cure cycle control color in the reinforced sheet. The higher acrylic monomer concentration and less vigorous cure show color superiority.

The exposure of the reinforced sheets to ultra-violet light causes a change in the factors controlling color. The initial color advantage of higher methacylate content persists, but does not show up as inherently greater ultra-violet light stability. The cobalt-type catalyst system (F_1) has a color advantage equal to that of the higher methacrylate content. This is the reverse of the results obtained from unexposed clear sheets that were considerably thicker and, therefore, would show the cobalt naphthenate absorption more strongly.

Although the thickness of the liquid resin absorption cell, the clear sheet, and the reinforced sheet differed considerably, the influential factors were considered separately within each group. Table 3 indicates the average values for the C.I.E.x color determinations for these different thicknesses and, therefore, no simple direct evaluation can be made of the total average color change upon cure or between the clear and reinforced sheets. This technique has an advantage, however, since it substantiates the fact found in comparing clear and reinforced sheet containing the cobalt-type catalyst system with respect to light stability.

The identical sheets were measured both before and after exposure so that the average color change due to exposure can be evaluated. This average color change is indicated as $\Delta x = 0.0018$. Taking advantage of the higher methacrylate content and the cobalt naphthenate catalyst system, the change can be reduced to 0.0003, or about one-sixth of the average color change for the panels studied. The color change can be reduced still further by using the IC-2 type light stabilizer and the more vigorous cure.

The color advantage of the milder-curing schedule disappears in 200 Fadeometer hours, while the more vigorous cure allows color advantage. This shows the inherently greater light stability of higher-temperature cured sheet, regardless which of the two catalyst systems investigated is used.

The color purity of the light transmitted by the reinforced sheet is increased with a decrease in methacrylate content. The use of IC-2 type light stabilizer and the more vigorous cure slightly increase the color purity.

The time required for the resins to wet the glass could not be measured accurately because of the interference of such uncontrollable variables as variations

in glass mat thickness (mats sometimes expand or contract unevenly in thickness upon first contact with the resin even though the weight per unit area is uniform). Consequently, the wetting properties of the resins tested were not analyzed statistically. It was determined that wetting time is definitely a function of the resin viscosity. Therefore, the wetting properties of a resin are related to some inverse function of the viscosity.

The viscosity of the uncatalyzed resin is controlled by monomer type and total monomer content. Vinyl toluene and n-butyl methacrylate, in the amounts used, increase the viscosity almost equally. Of the factors investigated, the total monomer content has the greatest effect on viscosity. Increased total monomer content leads to decreased viscosity. The monomer ratio, light stabilizer, and inhibitor have no effect.

The consideration of the gel and exotherm characteristics compared to the optical properties indicates that the two catalyst systems investigated are nearly equivalent in effectiveness. Even though the catalyst systems differ in efficiency, ample time to cure the sheets was allowed for any combination of factors.

Analysis of the actual gel time data indicates that the gel time is controlled by monomer ratio (C), inhibitor (E), catalyst system, and get cycle (F). Two interactions occur: one, between C and F; the other, between E and F. Shortest gel times occur with the combination of the 5:3 monomer ratio and the IC-1027 type inhibitor. The catalyst system has little effect on this combination. The combination of the 1:1 monomer ratio and the IC-420 type inhibitor produce the longest gel times, but the catalyst system has slightly more effect.

The catalyst system has a more pronounced effect on the combination of the 5:3 monomer ratio and the IC-420 type inhibitor. However, the effect on the combination of the 1:1 ratio and IC-1027 type inhibitor is most striking. Contrary to the other combinations, benzoyl peroxide when combined with the higher monomer ratio and the IC-1027 type inhibitor allows a quicker gel than the cobalt catalyst system.

Actual gel temperature determinations indicate no significant difference between resins and, therefore, no significant factors.

The exotherm cure time data run at the gel cycle temperatures indicates that benzoyl peroxide allows shorter cure times in all cases. Its effects when used with the various monomer ratios and inhibitors differ from that of the cobalt catalyst system and, therefore, interactions occur. Other significant actors indicate that the inclusion of vinyl toluene and the use of the high total monomer content decrease cure time.

Peak temperature is influenced by the catalyst system (highest with benzoyl peroxide at 170° F. bath temperature), monomer ratio (the 5:3 ratio increases the peak temperature over the average), and acrylic monomer type (the inclusion of n-butyl methacrylate decreases the peak temperature).

Analysis of the SPI-type exotherm characteristics indicates that all factors, except light stabilizer (G), influence the cure time and peak temperature. (Factors F, H, and J cannot be considered in the analysis of this data.) The factors influence the SPI-type cure time and peak temperature in much the same manner as the factors influence the cure time and peak temperature run at the gel cycle temperature and including the two catalyst systems. The notable exception is that with respect to SPI cure time, n-butyl methacrylate does not have a significant lengthening effect as shown by the cure time data determined at the gel cycle temperature. The inhibitor content of the n-butyl methacrylate is higher (0.01% hydroquinone) than the methyl methacrylate (0.006% hydroquinone) and, therefore, could cause this minor increase in cure time.

The SPI gel time is controlled by the inhibitor.

Conclusions

The appearance of the sheet will change with the components and methods of manufacture. The amount of light scattered will be reduced as sheets are made more transparent, and the color of the light scattered also may change. These changes in appearance can be related, one by one, to the changes in the make-up of the reinforced sheet studied in this investigation.

Haze percentage is a measure of transparency; the more light scattered, the less the transparency (see Figure 1). Haze percentage can be varied over a wide range by changing the resin formulation.

The color and color intensity of the scattered light are likely to change as transparency is changed. Generally, the color of the haze tends to redden with decreases in the refractive index of the resins, and its intensity increases. The color and color intensity of the haze can be controlled to some extent by the expedient use of different types and amounts of monomers.

In general, the haze color can be controlled over a wide-enough range to have the same general hue as the directly transmitted light which is controlled by pigment content. The haze might be made a different color than that directly transmitted for special effects.

Another point of interest brought out by the experimental data in Table 3 is the reduced difference in refractive index of the clear castings and the reinforced sheet upon the incorporation of n-butyl methacrylate at the lower total monomer content. It is reasonable to conclude that, by using the lower total monomer content and including some n-butyl methacrylate, the internal stresses set up in the reinforced sheet are reduced. This was partially verified by examining the panels in a Polaroscope. The group of panels containing less total monomer and/or more n-butyl methacrylate showed least evidence of internal stress.

Barcol hardness data also tend to substantiate this conclusion. n-Butyl methacrylate softens the sheet and reduces the flexural and tensile moduli of the resin. It follows that less stress would be created at the same level of strain. The fact that resins containing less monomer shrink less and, therefore, produce less strain at the same level of stress adds to the effect.

The color of the light directly transmitted is not too different from that of the light source. It can, therefore, be neglected for sheets containing pigments, and is relatively unimportant for unpigmented sheet.

Other factors that were shown by the study to in-

fluence the optical properties of the reinforced sheet include the following:

(1). A more vigorous cure cycle increases the amount of light scattered.

(2). Although the presence of binder on the mat increases the refractive index of the resin in the sheet very slightly, the amount of light scattered does not change.

(3). The transmitted color of reinforced sheets made with IC-420-2 HV and IC-1027-2 MMA HV Polyesters have as low a color value and are slightly more resistant to ultra-violet light than those produced from the IC-1 type resins.

(4). Sheets containing the cobalt-type catalyst system have a color advantage over the benzoyl peroxide system at either cure cycle after exposure to ultra-violet light.

(5). Sheets having a high methacrylate content transmit directly light of less color, but are not more light stable than those containing less methacrylate.

(6). Viscosity of uncatalyzed resin is a function of monomer type and content.

(7). An increase in total monomer content decreases the viscosity markedly.

(8). Substitution o vinyl toluene for part of the styrene or n-butyl methacrylate for part of the methyl methacrylate increases the viscosity. Pound for pound, the former is less effective than the latter.

(9). The SPI exotherm characteristics (2% benzoyl peroxide paste (50%) and at 180° F. bath temperature) are a function of inhibitor, monomer content and monomer type.

(10). The gel time is shorter when the IC-1027 type inhibitor is used.

(11). The inclusion of vinyl toluene; n-butyl methacrylate or the IC-420 type inhibitor lengthens cure time.

(12). The use of the 5:3 vinyl to acrylic monomer ratio decreases cure time.

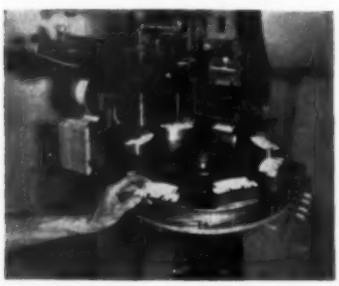
(13). The peak temperature is influenced by the factors in the same manner as cure time, except that the use of n-butyl methacrylate and the 1:1 monomer ratio decrease peak temperature.

Actual gel times and cure times measured at the indicated gel cycle temperatures were measured to determine the relative effectiveness of the two systems of catalysts. The results indicated that the systems are nearly equal in effectiveness, but differ in efficiency. Benzoyl peroxide is the more efficient for curing sheets in the shortest times. The cobalt catalyst system is more efficient for curing sheet to be more ultra-violet light resistant.

Acknowledgement

The authors wish to thank the Fiberglass Division, Ferro Corp. for invaluable assistance in supplying the fiberglass mats used in the preparation of the samples, and furnishing information on glass fiber technology.

—THE END



Acromark No. 2AH motor-driven hot-stamping unit.

The Time Element in Hot Stamping

Plastic parts marked by the hot-stamping method.

The momentary "dwell" of the die under pressure against the foil is said to be the most vital factor in hot stamping operations. Until recently, this time element was determined by the operator using a bench machine with a lever. Acromark Co., of Elizabeth, N. J., however, has developed a series of stamping machines which substitute an electronic device for human skills.

Acromark machines are set for temperature, pressure, and dwell; depending upon the plastic to be stamped and its contour. Flat-surface parts are imprinted with a direct stamping machine, whereas a rotary unit is used for cylindrical or spherical items. The firm manufactures Acroleaf foil in rolls of 200, 400, 600, and 800 feet, and in widths as desired.

HERCULES

Plastics Hi-lites

The hoops have had it ... now what?

Tremendous markets for new polyolefin plastics seen on all fronts

A new plastic—*high-density polyethylene*—was responsible for the hula hoop, undoubtedly the biggest product success story of 1958. There's no similar market windfall in sight for the coming year, but most manufacturers see this same plastic, and a still newer member of the polyolefin family—*polypropylene*—as their best bets for building increased consumer sales in '59.

Housewares, appliances, sporting goods and toys are among the many fields where product planners are now finding ways to whet customer buying appetites with these new plastics. Polypropylene made its bow at the January housewares show in Pro-fax® cutlery handles and dinnerware (*see below*). At the same time Cory Corporation made the first use of Pro-fax in a commercial coffee service.

While the hoops got much of the publicity about high-density polyethylene last year, this material made its most significant long-term gain in another direction. Development of the first thin-wall, non-functional Hi-fax bottle opened up a giant new market for plastics in carrier-type bottles. First employed as a container for Breck Banish, the new Hi-fax bottles were quickly adopted by users of other drug and cosmetic products. Several producers now offer a line of stock Hi-fax bottles in a variety of shapes and sizes.

Meanwhile some of the nation's leading "Soapers" have been market-testing liquid detergents in Hi-fax bottles, with such excellent results to date that a switchover to this new type package may be imminent. The big advantage of Hi-fax in this use, in addition to its ease of fabrication, is its outstanding resistance to stress-cracking.

All three members of the Big Three are sporting either Hi-fax or Pro-fax parts on 1959 cars. The many other applications under evaluation point to an increased use of both these plastics with the model change due next fall.

President A. C. Martinelli of Rogers Plastics Corporation points to his new Lady Arnold dinnerware line for which he selected Hercules Pro-fax.

PUTTING THE WEAR IN PLASTICS DINNERWARE . . . Pro-fax does it in the new Lady Arnold line to the extent that its manufacturer, Rogers Plastics, guarantees these dishes for life against chipping, cracking, and staining. Combining the beauty and elegance of expensive china with the low-cost durability of a tough thermoplastic, this new dinnerware is completely dishwasher proof, and molded in four lustrous pastel colors with a rich permanent gloss.

Hot tip for coffeemakers

A new pouring lip for Cory serving decanters, molded with Pro-fax, polypropylene plastic, looks better, lasts longer and costs less than conventional metal spouts. Cory Super-Tuf* pouring lips will take all kinds of abuse . . . won't dent, crack or stain from hot beverages or harsh detergents. Molded with black Pro-fax, they have a rich, glossy finish that is unharmed by high temperatures or hard use.

BETTER IDEAS FOR BETTER COFFEE ALWAYS COME FROM CORY . . . that's the company's motto and to prove its point Cory uses Pro-fax for a new type pouring spout unharmed by detergents and defying abuse.

Designed to combine with Cory's Majestic* glass serving decanter for the utmost in a modern, smartly styled coffee service, the new spouts can also be employed as replacement parts with current model Cory handles and neckbands.

**Registered trademark of Cory Corporation, Chicago, Ill.*

No trouble with Pro-fax

The manufacturer of this durable and attractive trouble lamp tried other plastics in the handle, but only Pro-fax proved up to the job. Equipped with U.L. approved cords, ranging in length from 20 to 50 feet in red, green, or black, with matching Pro-fax handles, this new trouble light features a push-button switch, convenience outlet, and cord strain relief, is oil, grease, acid, and alkali resistant. Pro-fax handles are molded by Precision Plastics Company, Philadelphia, Pa., for M. Black Manufacturing of the same city.

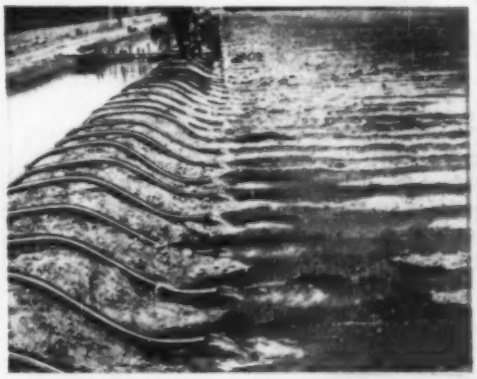
Market Hi-lites

A new cup produced by Crown Plastics Cup Company, Fort Worth, Texas, demonstrates the excellent moldability of Pro-fax in thin-wall sections. With a six-ounce capacity, the cups weigh less than a third of an ounce each, yet are unbreakable and can be sterilized. Among their first uses was in hospitals where with re-use after sterilization they have proved actually cheaper than the paper disposables formerly employed . . . Another new Pro-fax hospital item is a plastic bedside carafe and tumbler set manufactured by Zylon Products Company, Pawtucket, R. I. Completely autoclavable and fitted with a disposable plastic-film liner, this well-designed new product promises to revolutionize the entire technique of bedside water service. The first use of Pro-fax in an aerosol type package will be announced by one of the nation's leading cosmetic manufacturers within the next few weeks.

A 7½-inch Pro-fax rope has just replaced a 10-inch manila hawser on the Sinclair supertanker, S.S. J. E. Dyer. A product of American Manufacturing Company, the new plastic rope actually has greater breaking strength than its larger manila counterpart.

Good dam use for Hi-fax

Literally miles of Hi-fax tubing are being used here to siphon water over the high banks of a dammed-up ditch,



in the pre-irrigation of a cotton field. Hi-fax siphon tubes are becoming standard equipment throughout the irrigated West and South, eliminating the labor involved in cutting through ditch banks, providing better control of flow and reducing soil erosion. The Swanson Company of Phoenix, Arizona, first to produce the new Hi-fax tubes, promotes them as "tougher, lighter, with greater resistance to high and low temperatures and higher tensile strength." They are now marketed in lengths from 48" to 90" in both 1" and 2" Hi-fax tubing extruded by Arizona Plastics Extrusion Company, Phoenix, Arizona.

CP59-2

HERCULES POWDER COMPANY
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900 Market Street, Wilmington 99, Delaware

HERCULES

THREE NEW MATERIALS FOR THE PLASTIC INDUSTRY

HI-FAX® HIGH-DENSITY POLYETHYLENE • PRO-FAX® POLYPROPYLENE • PENTON® CHLORINATED POLYETHER

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *Engineering Editor*

Irradiated Plastic Applications . . .

. . . a laboratory curiosity only a few short years ago, is now completely entrenched with its own technology and equipment. This emergence has opened new fields in which irradiated plastics show improved performance or otherwise perform jobs hitherto impossible.

A recent advance in printing plate material has been field-tested by the DuPont laboratories. A plate made of plastic shows promise in simplifying the plate-making operation in Flexographic printing. The item, called a photopolymer plate, consists of a photosensitive plastic layer bonded to a non-sensitive bonding layer that incorporates an anti-halation coating. Previously, this plate has been prepared unsupported, but now is being laminated to a metal backing. A high-contrast negative containing text and half-tone illustrations is placed in contact with the photosensitive plate. This assembly is photo-printed using an ultra-violet radiation source for several minutes. The photosensitive plate is then developed in a mild alkaline solution that washes out the unexposed (unaffected) plastic. The irradiated plastic remains as a high-relief image suitable for use as a printing plate.

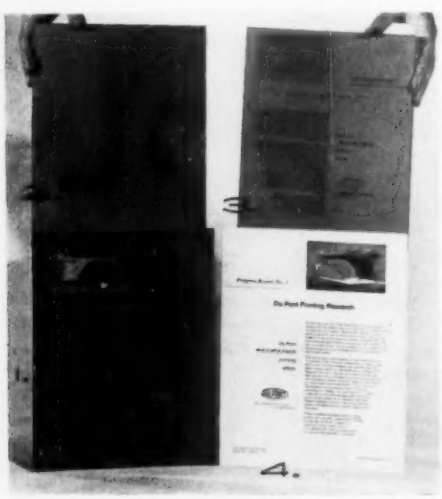

Photo courtesy: E. I. Du Pont Co.

(1). Photo-negative
(2). Photo polymer plate
(3). Developed plate
(4). Letter-press copy

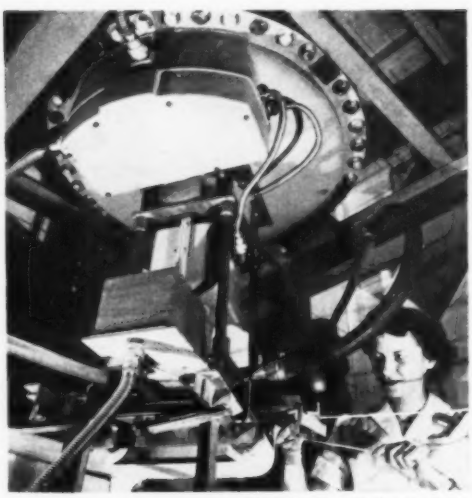

Photo Courtesy: W. R. Grace & Co.

The G-E electron beam generator blasts massive doses of electrons moving nearly at the speed of light into modified polymers to produce an altered and improved product.

Another point of interest to those who are decorating plastic web materials and blown bottles, is that this plate has been tested on offset printing machinery. In offset work, multiple color printing is possible by using multiple printing plates that transfer inks to an offset mat or roller which, in turn, transfers the multi-colored image onto the plastic part. Research with other forms of radiation, such as high-energy electrons, gamma rays, and neutron beams, has been tried. The General Electric Co. has produced a two-mev. beam generator. This machine is similar to the Betatron type of commercial X-ray unit and is presently being used to irradiate polyethylene wire-covering in a continuous process developed by Sequoia Process Corp. and Stanford Research Institute. Covered wire is upgraded in insulation value and higher temperature applications by this process.

Many articles have appeared in the literature describing the effect of radiation on polyethylene. All conclude, from the experiments performed, that a marked degree of cross-linking occurs in the polymer as shown by a greater insolubility of the resin, changes in tensile strength, and better form stability at higher

temperatures. More recently, radiation grafting of polymers has been tried using as a radiation source a two-mev. Van de Graaf accelerator. By this method, it would be possible to change the surface properties of a plastic without disturbing the core material; i.e., to graft a bondable monomer to a fluorocarbon polymer. This is said to be less costly than the ammonia-sodium treatment presently used. Such a procedure would also decrease the explosion hazard that is always prevalent when working with metallic sodium.

An experiment with an acrylic material given a charge under the beam of the two-mev. Van De Graaf generator, produces a frozen picture of a Lichtenberg discharge figure that is highly decorative. This figure is formed when the blocks are removed from under the beam and are pricked lightly with a sharp grounding point. By this means, the stored charge follows an erratic path of least resistance through the material, causing a tree-like pattern to be formed in the plastic block. What is seen is the crystallization of the acrylic material caused by the passage of the electric charge. These curious irradiated paper-weights were presented to the members of the press during their visit to the W. R. Grace laboratories near Washington, D. C. The laboratory that prepared the sample had just completed the installation of a High Voltage Engineering Corp. Van de Graaf accelerator that was to be used as a research tool in further probing the field of irradiation of plastic materials.

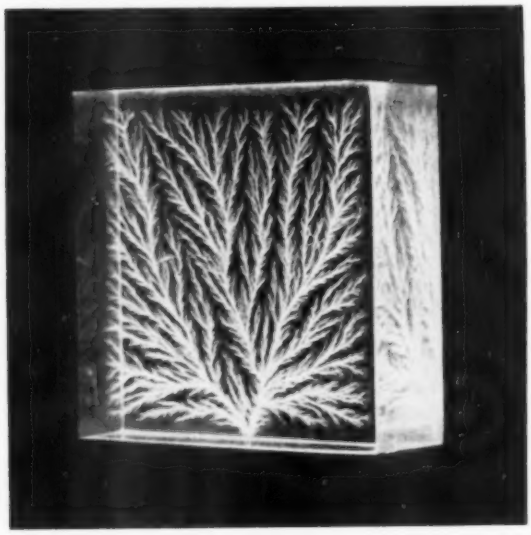

Photo courtesy: High Voltage Engineering Corp.

Lichtenberg figure in acrylic block.

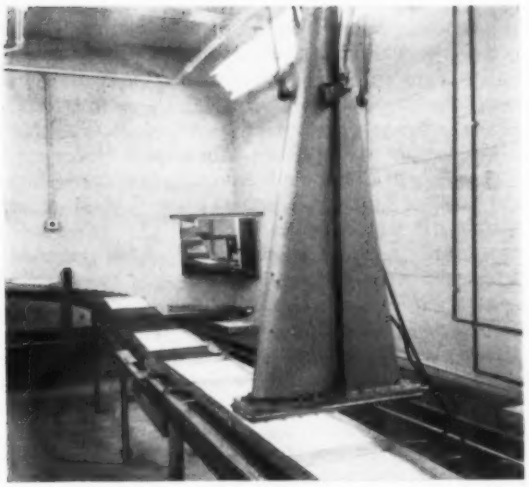

Photo courtesy: High Voltage Engineering Corp.

A close-up of typical irradiation vault.

●

Kaolin . . .

. . . the mineral laid down by nature in prehistoric times finds many applications in today's plastics industry. All too often when the word "kaolin" is seen or heard, the first things brought to mind are those pertaining to the potters' craft such as porcelains and other earthenware products. Actually, the paper industry uses far more of this chemical than do the ceramic trades, and today the trend in the plastics industry is to make more and better use of this ancient material. Its present use is as a filler in thermosetting resins, a mineral pigment extender, and as a water-proofing additive in many of the thermoplastic resins.

More correctly called kaolinite, which is a form of hydrated aluminum silicate, the material occurs as a crystalline scale or crystal stack that exhibits perfect basal cleavage. Non-abrasive, it finds use in polyethylene processing as an anti-block additive. Some other applications are as an additive to control the viscosity of polyester premixes, and as an extender in the preparation of melamaine products. When this material is partially calcined, it is known as meta-kaolin and its addition to PVC is said to improve its electrical characteristics. When used as a pigment, it exhibits high hiding power and, because of its whiteness is often used to extend the use of the more expensive (TiO_2) titanium pigment.

Many producers of fibrous glass-reinforced plastics use mixtures of kaolinite to reduce water absorption and to impart improved smoothness and gloss to the finished product.

The Georgia Kaolin Co., one of the foremost producers of kaolinite fractions in this country, has experimented with this material and its effects on various plastics. This information they have added to the literature. Many others have also prepared and presented papers on the subject to the SPE and the SPI. These papers are available from the Societies and the companies as reprints.

Another well known producer of aluminum silicate pigments is the Minerals & Chemicals Corp. of America, who presently has a fully integrated engineering program going on to further the use of this material in the plastics industry.

—The End

Developing the Custom Molding Market

(Cont'd. from page 41)

concentrate, the following seven facts should be studied:

(1). Yearly volume
(2). Dollar volume
(3). Growth potential
(4). Competitive possibilities
(5). Ease in which others can enter this field
(6). Advantages gained by using plastics
(7). Location of customers

Having established the areas where potential business can be found, we next want to analyze and initiate a working program. The custom molding market can be developed in a variety of ways:

(1). Work with various large raw-material suppliers who are constantly making market surveys. Pick one item that looks interesting and follow it through to determine its suitability to your operation, the number of available customers, and its saturation point. Material suppliers also maintain very active research departments supplying valuable data on trends and new uses for their materials. It is important to take advantage of this information and accept the help offered since it can prove most valuable in your search for new plastic applications and can help to develop and expand your market.

(2). Have within your own sales organization, a research and development department whose function would be to analyze constantly new fields or markets and make recommendations to the sales department. This department should be in a position to supply designs and models for use in gaining customer approval and for proving an application practical.

(3). Check with national trade associations to obtain information as to the size of the industry and its market potential. The U. S. Department of Commerce is another check source, plus directories such as Census of Manufacturing, etc.).

(4). It is important not to overlook any of your present customers.

(5). Exploring new fields for plastic use is your most important market, and should be constantly and thoroughly evaluated. The opportunities for new applications are unlimited. The comparison of a molded plastic item with one made from some other material may often show advantages in cost reduction, appearance, durability, weight, permanency of color, and design.

Important to remember are the two categories of plastic users: those who restyle their product every year; and those who have industrial applications that once developed, will last without changes for many years.

Having analyzed our preceding points, we must now think of how effectively we can launch a program that will promote sales.

The salesmen employed by custom molders must have a good basic and general knowledge of materials and their possible application. They must have general knowledge of industrial needs in order to be in a position to recognize possible applications. Also needed are a good mechanical or basic engineering background and a working knowledge of the plastics molding process.

Custom molding is a large segment of the plastics industry and has shown constant growth. There are numerous untapped fields yet to be explored. This demands that we continually stay on the alert for innovations in this constantly-expanding phase of plastics. The companies that recognize the unlimited possibilities and gear their organization accordingly can be counted among the leaders in custom molding.

—THE END

Coatings for Vacuum Metallizing on Plastics

(Cont'd. from page 35)

Dip coating is used to a limited extent. To minimize sags or tears, slow removal from the dip tank followed by wiping away the tear at the appropriate stage during drying sometimes is arranged.

Future Outlook

Looking ahead, it is easy to envision the rapid expansion of vacuum metallizing in quality applications during the next few years. It is already possible to produce parts rivaling the quality of commercial chrome-plated parts at substantial savings for a great number of applications. Although the hardness and abrasion resistance of chrome is not likely to be matched with a coating, the recent introduction of top coats having a hardness of 8-9H pencil lead rating indicates that, from a practical standpoint, there is an ever-widening number of applications where this process will be satisfactory and will offer major cost advantages.

The future of this field is controlled largely by the quality of coating and resin systems produced, since it is on these that the performance depends. This is increasingly important as the process finds wider application in such quality fields as the automotive and appliance industries. The need for continued improvement in equipment, of course, is desirable, and much good work is being done in this area by the vacuum plating-equipment manufacturers. The use of good ovens affording adequate temperature control, however, is commonly overlooked, as is adequate control in other phases of application. Attention to better control on the part of the applicator often could save him thousands of dollars in reject parts that must be stripped and refinished, or discarded.

The ability to mold plastics into complex shapes at low cost (even as compared to die-cast parts), and the ability to mask and plate sections of clear plastic parts, such as speedometer bezels and frames, all in one piece make plastics a natural substrate material for many uses. In view of the coatings already available and with the continuation of research in this field, the rapid expansion in use of plastics ranging from phenolics to acrylics as substrates for vacuum plating seems a certainty.

—THE END

GORDON B. THAYER, *Plastics Specialist*
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Developments in Plastic Materials—1958

THIS is the third annual review of "Developments in Plastic Materials" to be published by PLASTICS TECHNOLOGY. The review is intended to point out highlights that seem to be of interest to many people in the industry, but that are principally of interest to the compiler of the information. The reader of this review is likely to find several interesting evenings if he will conduct his own literature survey by reading the past year's plastics and engineering periodicals.

Sometimes questions will arise such as what happened to the polyethylene-carbon black molding formulation that was announced in 1957? Sometimes excellent technical articles will appear which the reader never noticed in the technical periodicals when they were current, and this will cause a side-tracking of the review operation for a few minutes to an hour while the interesting article is digested. Sooner or later, the reader will wish he could be brilliant enough to absorb all of the information published by all of the technical periodicals during the previous year. This puts him back on the track of continuing to make notes, and to include items that seem as if they should be of interest to many of the readers even though they may not be absorbed by the reviewer because of lack of brain space to include everything.

Each year there seems to be more and more to include in this review and more and more things, as well, that must be omitted.

New materials

The increasing need for higher heat-resistance of plastic materials for missiles and aircraft is behind experimental work that is being sponsored by the Navy's Bureau of Ships and the Air Force to make semi-organic compounds which can be handled as plastics. Boron is under extensive study at the University of Southern California, and some compounds have been developed that withstand 900° F. A few small references to the boron work have appeared, but it is expected that commercial development will be extremely limited at present.

Two materials which were reported in this department in 1956 and 1957 are Delrin and Lexan. Delrin, the acetal resin, has been the subject of many application papers which have been presented widely at various technical societies, with heavy concentration on meetings of the Society of Plastics Engineers. This material now is promised to be available in commercial quantities by the middle of 1959. It has been used for various types of rigid appliance housings and semi-structural applications for automobile instrument housing cowls. This material has been evaluated in many applications at the present time, and a considerable amount of engineering information now is available as Delrin approaches large-scale commercial production.

Lexan, the plycarbonate resin of General Electric Company, has been tested in more than 100 applications, according to a recent report of progress on this material. It, too, has been the subject of talks and discussions at technical society meetings during the past year, and it is becoming better and better known to more people.

Polyethylene

Polyethylene increased in volume of use during 1958 until it has been said to be the largest volume plastic

now manufactured. The total use approached 800,000,000 pounds.

The technical information on polyethylene grew tremendously during the year, and many technical papers appeared in all of the plastics publications, as well as in many others. Detailed studies of closely-limited projects have been reported. The study of the effect of crystalization on the transparency of polyethylene film is an example. Other studies concerned stress cracking, embrittlement, properties of fractionated polyethylene, early detection of weather damage, and dielectric measurements to determine the quality of carbon black dispersion. Many technical papers dealing with fabrication and applications of polyethylene also have appeared.

High-density polyethylene has gone into large-scale production by several manufacturers, and Union Carbide plastics has introduced six formulations of this material. Two of them are for injection molding, and one each have been for film, extrusion paper coating, blow molding, and monofilament and sheet. Most other manufacturers have limited their formulations to one or two types, but all are announcing plans to produce several more types of high-density polyethylene to match the application requirements.

The growth of medium-density polyethylene was very vigorous. This material has stiffness considerably higher than that of low-density material, and is much easier to fabricate than the high-density plastic.

From time to time new applications for various plastics appear on the horizon and if their full potential is realized, there will not be enough plastic capacity to supply the needs. One example is polyethylene bread wrapping sheet. It was estimated that this application will require 150,000,000 pounds of specialty film formulations per year.

A new fabrication method for making polyethylene articles has been tried out and described in the technical literature. It is possible to make blends of very high melt-index material with lower melt-index fractions for slush molding. The free-flowing melt is poured into a cold mold that either is rotated or not according to the type of operation. The plastic next to the mold chills to the thickness desired, and the remainder of the hot melt is poured out. The high melt-index materials are available from at least two manufacturers at the present time.

"The composition of matter" polyethylene patent claimed the rights for high-density polyethylene for E. I. du Pont Company. Polyethylene having a density between 0.950 and 0.970, with not more than 10% amorphous material, is covered in this controversial patent that was first publicly announced early in 1958. Several years may elapse before final settlement of the problems brought about by this development takes place.

Polypropylene

Moplen brand polypropylene, manufactured by Montecatini in Italy, has been reported in production at the rate of 15,000,000 pounds per year. An expansion has been announced to triple this capacity. Montecatini is ready to produce 15 tons of polypropylene fibers per month, according to another announcement. This material is manufactured in melt index 20 for film and bottle blowing, and melt index 6 for injection molding and extrusion. It has a specific gravity of 0.90-0.91.

Profax brand polypropylene by Hercules came onstream in January 1958, and is acknowledged to be America's first "home-grown" polypropylene. Texas Eastman at Longview, Tex., announced pilot-plant quantities of polypropylene last October.

This material has been subjected to many applications tests, and a great deal of engineering information is being assembled presently. There certainly is not as much experience and engineering data accumulated for polypropylene as for polyethylene, but it should not require very long to build up a large backlog of detailed information about polypropylene at the present rate of engineering evaluation.

Epoxy Resins

The field of epoxy resins is expanding very rapidly, both in applications and in types of materials that are classified in this general category. For example, Union Carbide Plastics has announced four kinds of epoxy resins. The first one is based on bisphenol and epichlorohydrin which is the original type of epoxy. A new type, Epoxide 201 brand, has low viscosity and pours readily. This means it can be used for complex castings which sometimes are subject to air bubbles because a viscous resin cannot fill all of the cavity. Two other types of intermediates, with long names, (dicyclopentadiene dioxide and vinyl-cyclohexene dioxide), can be formulated with acid hardeners to produce higher heat resistance by as much as 80° F. Amine-type hardeners are not required. Some simplification of names certainly will be appreciated when these materials become commercial.

Mixtures of epoxy resin and Portland cement have been employed increasingly as floor and paving compounds. The compounds can be applied in very thin layers, and adhere extremely well to old floors. They may be used to patch holes in concrete floors and decking to provide extremely durable hard finishes that save tremendously on cost of replacement of worn-out flooring.

A book on epoxy resins by Henry Lee and Chris Neville, has been published by McGraw Hill. It contains 12 chapters in a treatise that begins with the derivation of the resins and continues through the various applications and uses of the epoxy resins.

Polyvinyl Chloride

Rigid polyvinyl chloride is difficult to mold in injection machines because of the relative ease of degrada-

tion of the material. Plunger molding with electronic heating has been described in a paper by Union Carbide Plastics people. An alkyl-tin mercaptan stabilizer is used to provide good thermal stability. Plunger molding of rigid PVC is a great step forward in the technology of plastics, and should result in wider use of this plastic which has excellent chemical resistance and heat-resistant properties in its unadulterated state.

A new type of slush-molding plastisol and organosol base resin was announced by Goodyear under the brand name Pliovic VO. This material is useful especially for electrical insulation, and has outstanding shelf stability with good retention of original viscosity as it is used in the slush molding process.

Polyvinyl chloride has been superseded in its number one volume position in the United States by polyethylene.

Styrene Plastics

The styrene plastics continued in use at high levels during 1958, with some new developments worthy of reporting. Ultra-violet stability for polystyrene fluorescent-light diffusers has received a great deal of attention during the past year, and applications for polystyrene in the lighting field have grown.

The problem of static charge on the surface of polystyrene articles has bothered the plastics industry for years. This problem has received a great deal of attention through attempts to incorporate anti-static agents in the formulation to provide permanent relief from static dust accumulations. Monsanto recently announced their new Lustrex Lo-Stat brand of general-purpose and heat-resistant anti-static polystyrene formulation. The material has had many applications tests, and it is likely that the industry soon will find out whether the static dust problem is serious enough to warrant paying one cent per pound premium for the incorporation of anti-static agents in the molding formulation.

The field of shock-resistant polystyrene grows with more formulations available, and with the announcement of the availability of high-impact polystyrene from Foster Grant.

A copolymer of styrene and methyl methacrylate was announced by the Dow Chemical Company as Zerlon 150 brand plastic. This material is expected to have light stability between that of polystyrene and methyl methacrylate. It has 5% elongation which is expected to allow the use of metal inserts with much less danger of crazing and cracking than is encountered in polystyrene.

Acrylic Plastics

Considerable activity occurred in the acrylic resins field. Thin cast acrylic sheets of 20-, 30-, 40-, and 50-mil thick optically clear have appeared as commercially available. A new laminating resin has been test-marketed by DuPont that is described as an all-acrylic syrup. It can be used with fibrous glass to make colorless, highly light-stable, transparent panels that have up to 65% light transmission with 25% of chopped fiber mat.

An extrusion grade of methyl methacrylate Lucite brand has been announced by DuPont as having special properties which make it good for extruded sheet that has all of the well-known advantages of methyl methacrylate compound.

A high impact-type material, Implex brand, has been marketed by Rohm & Haas. This is a medium cost, modified acrylic molding powder that has been used extensively for shoe heels, among other things.

Thermosetting Materials

Diallyl phthalate molding compounds having fillers have been introduced under the brand name Dapon by Food Machinery Corporation. These compounds have heat resistance up to 450° F., and do not shrink on aging at elevated temperatures.

Reinforced Plastics

The meeting of the Reinforced Plastics Division of the Society of the Plastics Industry, held in February 1958, listed 16 technical sessions with approximately 80 papers presented. Building applications were stressed, as well as the molding compounds in the polyester and phenolic premix categories. Strength versus time behavior was studied extensively in this meeting.

Reinforced plastics are used as structural materials and, because of this, a great deal of information must be learned about their behavior under various conditions of use. This has resulted in the development of tremendous quantities of information on engineering properties, and the development of a great many different types of reinforcing materials for various uses. The temperature limits have been pushed up to as much as 4,000° F. for short-time exposure in missile uses. Many types of fibrous materials and hundreds of different plastic formulations have become available through the intensive development work which is now going on for building products and missiles.

Adhesives

The amount of information that appears concerning adhesives indicates a great deal of development work. Adhesives are becoming more and more accepted as materials for fastening possibly because there is no other way to fasten together many assemblies. Adhesives actually are a large proportion of the plastics manufacturing business, although they are not used generally in the manufacture of finished plastic articles themselves.

Expanded Plastics

Polyurethane foams are extremely versatile materials which can be injected very readily into closed spaces and then form foams to fill the spaces completely. It has been estimated that cushioning foams will reach a volume of nearly 50,000,000 punds per year for automotive and home furnishings. The Furni-

ture Show, in Chicago in January 1958, had items from 135 manufacturers who used synthetic foam cushioning.

Polyvinyl chloride foam has grown along with other cushioning foams and has its proper place in the field. A new polyester foam resin by Pittsburgh Plate Glass, Selectro Foam brand, is a flexible foam of high resilience with a density range of 1.6-15 pounds per cubic foot.

Expandable polystyrene beads have found more and more applications. One very interesting application has been described, and has reached considerable volume. This is hot drink cups which have a density of about 4-5 pounds per cubic foot, and retain the heat of hot drinks without allowing them to burn the fingers of the drinker. Airlines have found these cups ideal for use, but vending machines have not adapted them as yet due mainly to stack height. The cups costs slightly more than paper cups in the hot-drink classification, but not enough more so as to prevent their acceptance in sufficient volume.

Films

The subject of plastic films and film laminates is so broad that it probably should not be included in a review of this nature. It is impossible to point out all of the really significant highlights in this field. The SPI Film Division Conference devoted several days to discussions of applications and fabrication of films, and a great deal of technical information about the films themselves was presented.

Two new films appeared that may be of interest to people not closely connected to the film industry. DuPont introduced a vinyl chloride film under the brand name Type R, according to an announcement which appeared in May. This film is made principally from vinyl fluoride monomer, and is highly weather resistant. At the time of the announcement, it was described as available only as samples.

Trycite brand polystyrene film is to have expanded production facilities early in 1959.

Radiation

Studies of radiation with respect to plastics materials go on in what may be described as basic research fashion. The 14th ANTEC of the Society of Plastics Engineers in January 1958 presented seven papers on radiation, and the Pacific Coast Conference of the Society of the Plastics Industry presented a review paper on radiation.

It now is possible to rent radiation facilities at the Midwest Irradiation Center in Rockford, Ill.; the cost is stated to be $100 per hour. This seems to be a reasonable cost when one considers the total cost of such an installation and the high operating costs which are incurred.

Industry Notes

Two new simplifications of nomenclature were established during the year. The SPI established the term "TFE fluorocarbon resin" to indicate tetrafluoroethylene, and "FEP fluorocarbon resin" to indicate fluorinated ethylene propylene resin.

The American Society for Testing Materials established density ranges for polyethylene Classes I, II, and III which correspond to the old "low density", "medium density" designations. These two simplifications show that it can be done, and perhaps will lead to other simplifications of jaw-breaking chemical names for plastics.

Corporations merged and expanded without regard to recession conditions during 1958. They also formed international associations in considerable numbers. These associations included not only United States firms with foreign companies, but also German-and-French, Spanish-and-French, and German-and-Italian associations of significance in the world production of plastics.

Some significant price reductions occurred in the more mature plastics. Epoxy resins showed signs of maturing rapidly by an 18c per pound reduction from the end of 1957 to the end of 1958. Methyl methacrylate at 4c-, polyvinyl chloride at 6½c-, and polystyrene at 2c per pound reductions also are included among the significant reductions in costs of plastic resins.

—THE END

Comparison of Phenolic and Polyester Premix Materials

(Cont'd. from page 40)

material in preference to the other. On the other hand, the compounded phenolic premix material showed superior hot strength; high compressive strength; satisfactory flexural and impact strength; excellent resistance to boiling water, acid, and alkali solutions; good dimensional stability; excellent shelf-life; and relatively low raw material cost.

With the availability of two, low-cost premix materials, intelligent judgment must be exercised in selecting the best-suited material for a given application. It should be realized that the growth of the plastics industry depends upon those applications in which selection of the proper material results in the most satisfactory actual performance.

—THE END

Edited by:
HARRY T. DOUGLAS
Executive Vice President
Lunn Laminates, Inc.
Huntington Station, N. Y.

Reinforced Plastics

Need for a Plastics Institute

THE critical shortage of qualified reinforced-plastics engineers, or more broadly plastics engineers, in this country is increasing. There just are not enough well-trained, well-seasoned plastics engineers to go around. In addition to hampering the plastics industry in general, this shortage prevents us in the R-P field from advancing further. It stymies the research and development of fiber glass fabrication for many commercial products that could and should be made from R-P materials. But most important, it is felt in military projects where new R-P applications may spell the future of our missile program, our submarine progress, and our interplanetary achievements.

More than double the percentage of R-P materials is being used today on missile bodies compared to a year ago. Submarine components for the Nautilus and other subs have been produced for the first time from R-P. It also is possible that space stations and rocket ships could be made with large sections of fiber-glass laminates because of the inherent characteristics of this versatile material.

Reinforced plastics is no longer a baby in swaddling clothes, not when it has grown up sufficiently to be used in such strategic military applications as it is. But all of this takes research, skilled personnel, and capital.

Looking around us, we see many uses of plastics. This part of the century has been heralded as the "Plastics Age"—but in this growing field, we still are in the Stone Age of our thinking because we lack a fundamental supply of trained personnel to meet the challenge of this decisive era.

Dr. Werner Von Braun stated recently that it is the lack of sufficient scientific know-how and money which is a deterrent in the widening gap between us and the U.S.S.R. in the race for world supremacy. Where the money problem for military experiments has to be resolved by government officials, I believe that capital is or can be made available from industry to help solve the shortage of plastics engineers.

The two large groups of peoples primarily concerned with furthering the interests of the plastics field are the S.P.I. and the S.P.E. These organizations have been instrumental in bringing profound changes in the field, distributing valuable information, and in educating the public to the meaning and potentials of plastics. It is through them and their nation-wide chapters that interest can be fostered to establish a "Plastics Institute."

At the present time, only a handful of colleges offer a plastics course in their general engineering programs. One such course was reported to be only three hours. A few chapters of the S.P.E. (New York, for one) commendably have been launching educational tie-in programs with local high schools and colleges. Due to insufficient funds available for equipment, space, and trained instructors, this is a big up-hill fight.

My suggestion is that instead of leaving such important work to local groups that have neither the time nor money to invest properly in such a vast undertaking, the SPI and SPE should pool their resources and call upon management to help underwrite an independent plastics institute, and not be dependent upon local charitable souls to find ample time for this "sometime" thing.

First, is the furthering of plastics of sufficient concern to us as an industry and as a country? Evidently it is, or should be, purging from the past, present, and future activities in this field. If such is the case, then appropriation should be made conscientiously to establish a suitable school where engineers can be adequately trained to fill the growing needs of this vital field. Income from tuition and contributions from industry can help underwrite such a program.

I do not want to minimize by any means the mammoth amount of work, the many details, and clearances

(Continued on page 62)

Edited by:
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The Fiberite Corp.
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Compression & Transfer Molding

Assignment: Empirical Cure Times in Phenolics!

ONE of the most vital areas of engineering for the molder is estimating costs. An error in one of the basic calculations of an estimate can multiply itself as the direct and indirect labor, overhead charges, press expense, and, finally, mark-up are applied. The most basic of calculations affecting a company's profit or loss is piece-part production rates. Pieces per hour (or shots per hour at the press) involve a repetitive cycle consisting of many elements; e.g., blow, load, close, breathe, re-close, cure, open, and unload. The element this article is concerned with is cure time.

A few months ago one of Fiberite's field sales trainees Ed Atkinson, took on the project of establishing an empirical method of computing cure times for standard grades of phenolic molding compounds. Ed Atkinson was in a training program even though he is a highly-qualified graduate mechanical engineer with a plastics background from the Bakelite Company (now Union Carbide Plastics).

With "tongue in cheek," I proceeded to describe the many variables in cure times that can cause consternation to the most experienced estimator. Ed Atkinson recorded all the reasons why his assignment was well-nigh an impossible one.

Some of the variables that affect cure time are as follows:

(1). Temperature extremes from 290-350° F. can be used.

(2). Plasticity values of the compounds available have a wide range. A molder may base his selection of flow plasticity on the basis of his available molding pressure, type of mold design, and part design. Each factor affects his flow selection and cure time. Of course, optimum cure time and dimensional control are influenced by flow selection.

(3). Method of preheating, if used, will affect cure. The fast preheat, through the use of electronic apparatus, will not give quite the same cure time as the slow, hot oven or the steam oven method.

(4). A molder needing close control of tolerances, shrinkage, and post-shrinkage will have to cure longer.

(5). Cure times are affected by the types of fillers or additives used in the molding compounds. Additions or supplementations to the compound are included often to improve properties such as wear resistance, fatigue resistance, flame retardance, heat resistance, moduli of elasticity, etc.

(6). The phenolic resin-type may be one- or two-stage, low pressure, or a modified combination. Cure time depends on handling and molding techniques, since each resin type reacts differently.

(7). The amount of volatility that could be present due to the solvent content, the flow, and atmospheric conditions is a variable. Of course, the wise molder wants his "powder" dry.

Our young engineer traveled far and wide. He explained his project to the molder and asked if he couldn't record their cure times and conditions on as many as possible of the moldings currently running. Most molders were happy to cooperate; wished him luck; and asked for a copy of his results when completed.

It must be explained that the cure times to be indicated are for conventional molding techniques as commonly used by the greatest number of molders. Faster cures are possible with the improvements being made by our large basic suppliers. For use in the newer presses where press-closing times are a matter of seconds, the duration of flow (not to be confused with plasticity or soft-to-hard flows) is being reduced. The duration of flow, being somewhat a constant, can add to the apparent cure time since the compound must set before cure begins.

And now for the report:

Estimating Cure Times for Molded Phenolic Parts

by Ed Atkinson
Fiberite Corp.

A rather detailed case study was made on the subject by visiting several molders, examining molded parts, and recording the conditions and cure times in use.

The standard known variables affecting cure were taken into consideration on each case study. An analysis was made, and a base empirical cure chart with allowances for variables was developed.

The following are the variables taken into consideration:

(1). Cross-section of piece.

(2). Mold temperature.

(3). Type of resin (one- or two-step).

(4). Use of preheat. Optimum preheat about 180° F. Preheat (electronic) time and temperatures are affected by volatile content of compound. Other than electronic preheat methods were not considered.

(5). Compression or transfer (plunger) molded. Compression molding cures can be affected by type of mold (positive, semi-positive, or flash) and "flow to fill" time. In this case, only the relative difference between compression and transfer is given.

(6). Mineral content. Mineral content usually can be noted by observing the specific gravity.

(7). Use of glass filler.

(8). Degree of plasticity ("hard," "medium," or "soft" flow).

(9). Degree of cure desired: standard (to point of no blister), or optimum (for best electricals, heat dimensional stability, heat and chemical resistances, hardest surface, and for less than 3% acetone-extractable uncured resin).

Three variables that were *not* taken into consideration, but which may affect the ultimate cure needed, are as follows:

(1). Design of part; i.e., some parts would require longer or shorter cure times because of special configurations.

(2). Relative reactivity of a molding compound other than whether it is a one-step or two-step. A given compound can be made more or less reactive by the material supplier with the inclusion of special additives and/or by the use of special processing techniques.

(3). Differences of equipment characteristics and/or molding techniques from one molder to another. This especially is true in preheat techniques whose variables hardly could be considered in such an analysis.

Even though these unrecorded variables do exist, this analysis has proved to be reasonably accurate for estimating cure time on a general basis.

For purposes of simplifying the use of allowances, an empirical cure chart will be used as the basis for deriving all cures.

Starting with the maximum cross-section of the piece and the proposed mold temperature, extract the cure time from chart. If the molding compound is a one-step phenolic, subtract the time indicated in the following chart (for the corresponding maximum cross-section) from the empirical cure time.

Max. Cross-Sec., In.	Time to be Subtracted, Min.:Sec.
1/8	0:20
1/4	0:30
3/8	0:50
1/2	1:10
5/8	1:40
3/4	2:00
7/8	2:10
1	2:15
1 1/2	2:45

If the compound is preheated, subtract 15 seconds per 1/8-inch maximum cross-section. If the compound is "hard" flow, subtract 10 seconds per 1/8-inch thickness up to 3/4-inch section. If the compound is "soft" flow add 10 seconds per 1/8-inch thickness up to 3/4-inch section. If the maximum cross-section thickness is over 3/4-inch, add or subtract as indicated (for hard or soft flow) using five seconds per 1/8-inch thickness. (Note: Improper molding pressure depriving molded part of its proper density will affect apparent cure.)

If the compound is mineralized (other than glass filler), deduct 20% of above derived cure time thus far. (Note: Observe specific gravity of compound.) If the resin is one-stage and the compound is glass-filled and the part is not over 1/4-inch thick, deduct 20% of derived cure. If the compound is glass-filled and the part is over 1/4-inch thick, subtract 25% from derived cure. If the part is to be transfer or plunger molded, use 75% of derived cure. If optimum cure is desired (where best electricals, etc., are to be obtained), then add 15% to above cure. We now can arrive at an es-

(Continued on next page.)

Empirical Cure Chart*, Time in Min.:Sec.

Max. Cross-Section Thickness, in.	Mold Temp., °F.					
	300	310	320	330	340	350
1/8	2:20	2:10	2:00	1:50	1:40	1:30
1/4	3:40	3:20	3:00	2:40	2:20	2:00
3/8	4:45	4:15	3:45	3:15	2:45	2:15
1/2	5:50	5:10	4:30	3:50	3:10	2:30
5/8	8:10	7:20	6:30	5:40	4:50	4:00
3/4	9:45	8:45	7:45	6:45	5:45	4:45
7/8	10:50	9:40	8:30	7:20	6:10	5:40
1	11:40	10:20	9:00	7:40	6:20	6:00
1 1/2	13:00	11:30	10:00	8:30	7:00	6:30

*Basis: Medium-flow, two-stage resin; no preheat, no additives, compression (semi-positive) molded, standard cure.

Low-Density Cellular Vinyl by Post-Expansion Methods
(Cont'd. from page 31)

Expansion Oven

A forced hot-air oven has proved suitable for expanding a calendered sheet. It is very important that the proper temperature be used (see Table 3). Each compound-blowing agent system will have an optimum temperature which, in the case of the standard compound (Table 1), is 370° F. Expansion, as described earlier in the Extrusion section, also can be accomplished by this process.

Cooling & Take-Up

Forced air is both an adequate and convenient method of cooling expanded material. There is no distortion or deformation.

Since a study of take-up equipment was not made, no one type is recommended. It should be borne in mind, however, that the material involved is cellular and, as such, should not be pressed tightly or wound, especially if still warm.

Properties

Although the structure may vary as the compound changes, the product is generally characterized by a thin, non-continuous skin and a blend of open and closed cells (see Figures 5 and 6).

Vinyl-nitrile rubber blends and rigid vinyl materials tend to have a thicker skin and a higher percentage of closed cells than do the plasticized vinyls. A water-absorption test commonly is used to determine the permeability of the structure. Current specifications consider a cellular product with less than 5% water absorption to be a closed-cell type.

The physical properties of these materials are characterized by their vinyl base. The use of vinyl, therefore, imparts thermoplasticity, flame resistance, compoundability, heat sealability to these cellular products, and exceptional aging stability. Physical properties, such as compression-deflection, resiliency, hardness, water absorption, and strength, can be varied widely through compounding.

Applications

The specific applications of low-density cellular vinyl will determine to a large extent the property requirements as well as the method of processing—calendering or extrusion. For this reason, the discussion of applications has been separated into two processing areas.

The extrusion process of producing low-density cellular vinyl lends itself well to two fields of application requiring materials already expanded, and materials expanded-in-place.

With pre-expanded materials, the compression-deflection, hardness, and density characteristics render these products excellent for door windlaces, window gasketing, gaskets for container covers, and gaskets for cushioned metal-to-metal contacts. The good insulating properties attributed to the structure make this material applicable for use as weatherstripping, insulation for thermal joints, and refrigeration gaskets.

Since the low-density cellular products can be produced in a wide range of hardness, they also can be employed in such varying applications as light-weight, rigid support struts; flexible joint fillers; moldings and coving (flexible or rigid); and welting for specific applications.

It is usually desirable that a material be applied and then expanded in situ. Previously, plastisols were the only vinyl compounds which could be used for this purpose. Since low-density cellular vinyl can be processed and then expanded at some future time by the external application of heat, it is ideal as cable fillers and separators, and joint fillers. The overwhelming majority of uses for calendered sheet lie in the pre-expanded field.

The cushioning properties and the process advantage of calendering directly onto a fabric or similar material can be realized in applications such as rug underlays, floor and wall tile backings, upholstery, and paneling. The properties of calendered sheet render it useful to the construction field as acoustical material; vibration dampener; wall covering; light-weight, thin insulation for panel construction; and decorative moldings and panels.

Conclusions

A technique is presented which can be used to produce low-density cellular vinyl products with conventional vinyl extrusion and calendering equipment. Products ranging in hardness from soft and pliable to rigid and hard can be obtained. Materials produced with this technique can be applied not only in an expanded form, but also in a form suitable for expansion-in-place.

—THE END

Reinforced Plastics
(Cont'd. from page 59)

of one kind and another that are necessary to get such a project started. Space prevents me from going into this much further. It might be that the "Plastics Institute" should be part of a college; or some readers might think that, in view of possible difficulties which such an alliance might foster, perhaps the best interests of a school of that type would be served if it were a separate entity. Opinions pro and con regarding a "Plastics Institute" are welcome.

—THE END

Compression and Transfer Molding
(Cont'd. from preceding page.)

timated cure time with the listed variables being taken into consideration. (Note: For parts operating at elevated temperatures, a degree of after-shrinkage can be expected. Ways and means of control is a subject matter in itself. Contact material supplier in all cases when elevated temperatures are of concern.)

Comments will be appreciated. Please check out the above method and let us have your comments.

—THE END

NOW NEW FIRST and ONLY

static dissipating styrene molding powder

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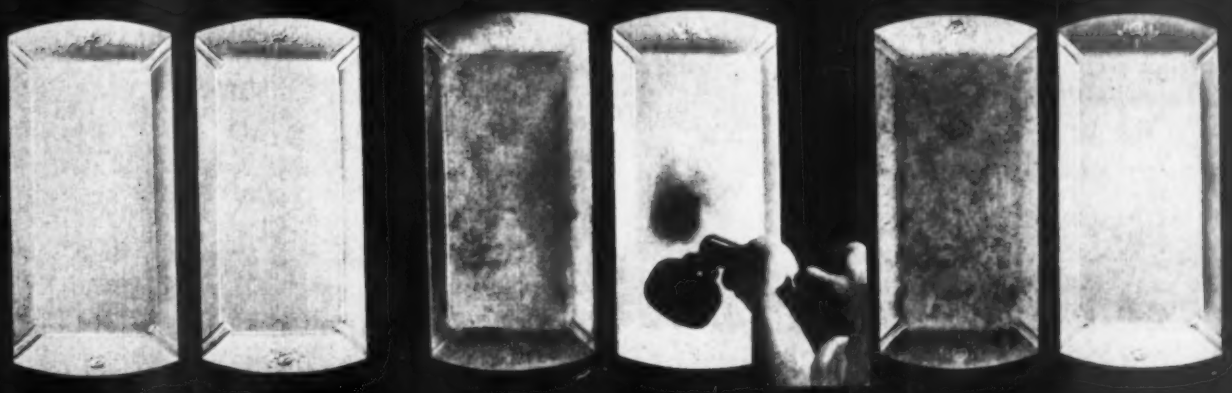
Translate this test into new production economies and sales advantages:



1. Two trays from same mold. Left: molded of standard material. Right: molded of Lustrex Lo-Stat.

2. Charcoal dust is sprayed on both trays.

3. Result! Dust pattern on standard tray corresponds to static electric charge. Tray of Lustrex Lo-Stat is practically clean. The little charcoal remaining is easily tapped off.

Think what Lustrex Lo-Stat can mean in keeping housewares clean and appealing, how much longer signs, displays and packages will stay attractive. Air conditioner and fan grills are other moldings that will be improved. There are dozens of jobs that Lustrex Lo-Stat dust-resistant styrene can do better. And production economies include the elimination of spraying and bathing; open storage and simplified handling. Lustrex Lo-Stat is in full production. Send for a trial quantity now along with complete technical data. Monsanto Chemical Company, Plastics Division, Room 1077, Springfield 2, Mass.

Monsanto

LUSTREX: REG. U. S. PAT. OFF.

News of the Industry

new polypropylene manufacturer

AviSun Corp. is the name of the United States' second supplier of polypropylene. An equally owned affiliate of **American Viscose Corp.** and **Sun Oil Co.,** the company is scheduled to be the nation's largest commercial supplier of the new plastic by midsummer.

Sun scientists have developed a process for the manufacture of polypropylene resins, and American Viscose researchers have come up with new processes for making film and fibers. AviSun has leased facilities of **Koppers'** Port Reading, N. J., linear polyethylene plant. Koppers will operate the process under the technical direction of Avi-Sun, and the capacity has been estimated at 20-million pounds annually.

Chalmer G. Kirkbride, executive director of research and engineering for Sun, has been elected president of the new company. Other officers include William H. Brown, vice president and treasurer of Viscose, as treasurer and assistant secretary; and Joseph T. Wilson, Jr., assistant secretary and assistant treasurer of Sun, as secretary and assistant treasurer of AviSun.

Until commercial production is underway, Sun Oil is providing pilot-plant quantities of the new polymers and copolymers under contract to Avi-Sun, and the manufacture of film and fibers is being handled by American Viscose. Concentrated olefins for commercial production will be supplied by Sun Oil, as far as possible.

epoxy resin symposium

Reichhold Chemicals, Inc. held its first symposium on Epotuf epoxy resins at the RCI Plasticenter in Elizabeth, N. J., last December. Attended by many surface-coating formulators, the meeting reivewed epoxy characteristics and chemistry, as well as provided specific data on surface coating formulations. Other such symposia are planned for the future.

plastics technology course

Philadelphia Textile Institute is currently running a 12-week course in plastics technology, which meets for three hours on Monday evenings. Eighty-one students are enrolled, and represent 31 firms from Pennsylvania, New Jersey, and Delaware. Topics include: the nature of plastics and their properties, development of the plastics industry, design of plastic parts, new techniques in plastics, combinations of plastics with other materials, and new fields of application for plastics. Instructor for the course is Sidney Levy, currently senior materials consultant on non-metallic materials to RCA and a plastics consultant for 12 years.

forms new corporation

Fome-Cor Corp. is the name of a new company, owned jointly by **St. Regis Paper Co. and Monsanto Chemical Co.** The firm will manufacture and market a foamed plastic and paper laminated by a continuous process into a sandwich with high compression strength under very moist conditions. A good insulator and cushioner, Fome-Cor sandwiches should find wide applications as containers, displays, stage settings, and the like. Temporary headquarters for the new company are in Springfield, Mass.

cancel caprolactam venture

Spencer Chemical Co. and Industrial Rayon Corp. have cancelled their plans for constructing a $10-million plant in Ashland, Ky., to manufacture caprolactam, a raw material used in the manufacture of nylon. The joint venture, under the name **Ohio River Chemical Co.,** was first announced last summer. The planned entry into the caprolactam field by another large chemical company would make it unnecessary and less profitable for the parent firms, according to their joint statement.

radiation grafting of fluorocarbons

Radiation Applications, Inc., of New York City reports that it has added bondability and surface-dye-acceptability to fluorocarbon polymers by means of radiation grafting. The firm estimates that this technique will reduce the costs of modifying Teflon and Kel-F about 25%. Technical assistance in dyeing was provided by the Tintex division of **Schenley Industries,** a substantial stockholder in RAI.

national toy show

The first National Toy Show to be held in Chicago, at the Morrison Hotel, opens May 17 and will run through May 21. Focal point for a $1.5-million market, the show is expected to draw 10,000 buyers and at least 500 exhibitors. It will be managed by **Jules Karel & Associates,** 8 South Dearborn St.

textured vinyl coatings

Union Carbide Plastic Co.'s vinyl resins are being formulated by J. L. Armitage & Co. to provide the Armorette coating for the exterior roof of the Chrysler Imperial Southampton. This coating lends a black, grained-leather appearance to the landau area of the hardtop, and provides a striking contrast to the brushed, stainless steel forward section.

organizational changes

General Electric Co. is realigning a number of departments, and is expanding the chemical and metallurgical division; however, there are no physical relocation plans for any of the manufacturing facilities. The C&M division headquarters are being transferred from Pittsfield, Mass., to Bridgeport, Conn., and the following departments of the former construction materials division have been assigned to it: conduit products department, wire & cable department, and the wiring device department.

The chemical & metallurgical division already operates the following departments: chemical materials, laminated products, silicone products, metallurgical products, plastics, and insulating materials. Headquarters of the chemical development, currently undergoing reorganization, also will transfer to Bridgeport; however, process laboratories will remain in Pittsfield.

Robert L. Gibson, G-E vice president and general manager of the C&M division attributed the move to the need for the general manager to be located in a major G-E plant city. The realignment brings together businesses closely related through common technologies, since the new departments use large quantities of materials manufactured within the division.

Hooker Chemical Corp. will divisionalize further through the formation of an autonomous Eastern Chemical division, and by making the Phosphorus division autonomous. Both new divisions will be on the same basis as the Durez Plastics division. Thomas F. Willers and F. Leonard Bryant, vice presidents, are to be appointed general managers for the Eastern and Phosphorus divisions, respectively.

do-it-yourself vacuum forming molds

Union Carbide Plastics Co. demonstrated an inexpensive method of producing vacuum forming molds—from sprayed epoxy resins flocked with aluminum fibers. Suited for short runs and prototypes, the molds are made by applying a release agent on the pattern followed by a gel coat containing flaked stainless steel. The first layer of metal fiber is applied while the gel coat is still wet. About a half-hour later, resin and fiber are applied to a thickness of approximately ⅛-inch. After compacting, a second layer is applied and compacted. When the formulation has hardened, the mold is removed from the pattern ready for trimming and installation. **A. Gusmer, Inc.** collaborated with Union Carbide in the basic research.

plastics in medicine

American Cyanamid Co.'s L. J. Francisco, assistant manager of the plastics & resins division, recently revealed that polyethylene foam is now being used to fill chest cavities when lungs have to be collapsed. Another plastic material, polyvinyl pyrrolidone, is currently used as a blood extender. Plastics have found extensive use in vascular surgery, he added, replacing parts of veins, arteries, and valves. Prosthesis, too, employs plastics in ever-increasing quantities.

changes in company ownership

Nosco Plastics, Inc., Erie, Pa., has been sold to **Holgate Brothers Co.,** a wood working and toy firm of Kane, Pa. One of the largest injection molding plants in the country, Nosco employs more than 200 persons in a 227,000 square-foot plant. Robert C. Houser becomes president and chairman of the board is James C. Leslie. Operating management, however, remains virtually unchanged with Paul C. Roche continuing as vice president and general manager and Harold C. Cloyd retaining his position as vice president and chief development engineer. Reuben G. Kugel, former Nosco president, remains with the company as vice president and consultant.

Rexall Drug Co. has completed negotiations for the acquisition of **Chippewa Plastics, Inc.,** of Chippewa Falls, Wis. The transaction calls for the exchange of one Rexall share for two shares of Chippewa common stock, and appropriate adjustments for Chippewa preferred. The move is primarily one of growth, with Rexall financing Chippewa's expansion program.

molded vinyl-foam cushioning

International Furniture Co. is using **Union Carbide Plastics Co.'s** molded Vinylfoam in a number of sofa and occasional pieces this year. In addition to cost considerations, vinyl foam cushioning is fire-resistant, resists oxidation and hardening, and keeps its resiliency.

plastic pipe warranty

Orangeburg Mfg. Co. has issued a 20-year bond guaranteeing the performance of its SP plastic pipe in cold water service lines. The Bond, backed by a national surety company, guarantees to the extent of the bond that any repairs or replacements due to failure of the pipe will be made at the expense of Orangeburg. The firm stipulates only that the installer complies with a few installation instructions. Thirty days later, he applies to Orangeburg for the bond.

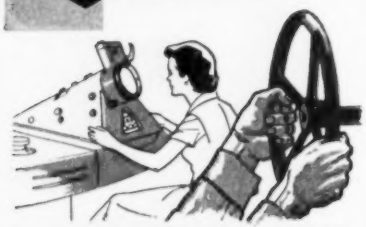
hastings named reichhold agent

Hastings Plastics, Inc. has become exclusive distributor of **Reichhold Chemicals'** line of basic polyester, polyurethane, and phenolic resins for aircraft and missile applications in Southern California. The agreement also permits sales to all other industries on a cooperative basis with RCI field personnel.

reinforced plastic lifeboats

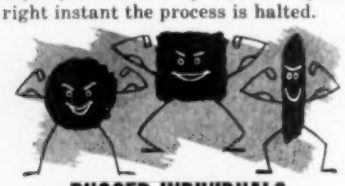
The U. S. Coast Guard has approved Fiberglas-reinforced polyester lifeboats for use on all American passenger and cargo vessels. The boats passed the most severe tests ever given to any type of lifeboat, simulating the worst conceivable sea conditions. In one, a 1½-ton craft was loaded down with 4½ tons of sand and dropped into the water from a considerable height. Another test repeatedly slammed the boat against a concrete pier.

COLLOID CORNER



COUNT-DOWN TO INNER SPACE

It takes an electron microscope to see a Mapico synthetically-grown iron oxide particle. Yet despite this minuteness, Mapico technicians know exactly when to stop the particle-building process to achieve precisely the particle characteristics desired. The process may last two weeks or longer—more than 72,000,000 seconds—yet at exactly the right instant the process is halted.



RUGGED INDIVIDUALS

Mapico iron oxide particles have many sizes and shapes which provide a wide variety of colors and characteristics for use in rubber, paints, inks and polishes. Among these controlled characteristics are apparent density, binder requirement, suspension, hiding power, ultraviolet screening and uniformity.

MAGNET FOR MILLIONS

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DEPT. A

News of Industry *(Cont'd.)*

corporate moves and expansions

J. M. Huber Corp.'s industrial products department has moved from 100 Park Ave. to 630 Third Ave., New York City. The larger space will not only house the above-mentioned department, but also Huber International and the finance & traffic departments. Huber markets carbon blacks, chemicals, and Kaolin clays.

Automold Co. is the new name for **Automatic Molding Machine Co.,** a subsidiary of **Wagner Brothers, Inc.** The company also has moved to new and larger quarters at 2231 South Butler Ave., West Los Angeles, Calif., though the Eastern sales office remains at 400 Midland, Detroit, Mich. The 10,000 square feet of plant area now available allows for increased production of Automold Models A25B and A50B compression presses, and for development of the Automold line of automatic transfer and injection molding machines.

Ryko Products, Inc., Los Angeles, Calif., is adding 5,000 square feet of manufacturing area to its existing extrusion and fabricating facilities at 814-24 San Fernando Road. The annex will house additional equipment, with emphasis on extrusion equipment for polystyrene and acrylic. Completion is scheduled for next month.

Mobay Chemical Co. has announced plans for a 50% expansion in toluene diisocyanate production at New Martinsville, W. Va. This is the second major expansion since the plant went on stream in 1956, and will up the capacity to 18-million pounds annually. New facilities should be completed by early 1960. TDI is one of the basic chemicals used in the manufacture of urethane foam cushioning and insulating materials, elastomers, and industrial coatings.

Monsanto Chemical Co.'s plastics division plans to expand its high-pressure polyethylene facilities in Texas City, Tex. to permit production of 100-million pounds per year. Construction work is currently underway, and completion is expected by fall of this year. New methods were developed for obtaining higher automated productivity and better control of properties, and these processes will be instituted at the Texas City plant.

Nopco Chemical Co.'s plastics division plans to triple the size of its present plant in North Arlington, N. J., to provide six times the present capacity for making flexible polyurethane foams and to house additional foamed-in-place systems. The $500-thousand expansion should be completed by July 1, and is the firm's second major construction for plastics manufacture in three years.

Tennessee Eastman Co. has enlarged its Tenite plastics development laboratory in Kingsport, Tenn., by 5,000 square feet to accommodate additional equipment and personnel. The move is expected to broaden the firm's services to the plastics processing industry and to expand applications research in such allied industries as packaging, automobile components, communications, pipe, toys, and housewares.

Commercial Plastics & Supply Corp. has moved to new, larger facilities at 424 N. Craig St., Pittsburgh, Pa. The move provides three times the space previously afforded, and should greatly improve receiving and shipping facilities. National headquarters are located in New York City.

Glascoat fiberglass, distributor and representative for Celanese, Ferro, Union Carbide Plastics, and Specialty Chemical, has moved into its new general offices and warehouse at N. W. 170th St. and Second Ave., North Miami, Fla. The firm maintains its branch office and warehouse in Atlanta.

more about johns-manville fiber glass

Two months ago we reported that **Johns-Manville Corp.** formed a subsidiary, **Johns-Manville Fiber Glass, Inc.,** which purchased L.O.F. Glass Fibers Co. The new firm has taken over the management of seven fiber glass plants and a research and technical center. R. H. Barnard has been elected president, the position he held with L.O.F. Francis H. May has been elected vice president and general manager. Division general offices are located at Toledo, O.

The new division is a research, development, and production unit only. It will supply fibrous glass products to five other divisions: Industrial Insulations, Building Products, Celite, Canadian Products, and the International division. The sales organizations of these five divisions, augumented by the former L.O.F. sales organization, will distribute the J-M fiber glass products.

new plants and laboratories

Continental-Diamond Fibre Corp. has announced plans for the construction of a $350,000 research center to be located in Newark, Del. The company plans to consolidate its entire research effort at the new facility, which is scheduled for completion in August of this year. CDF plans to develop new grades of vulcanized fibers, laminated thermosetting plastics, bonded mica, and Celoron molded plastics.

Hooker Chemical Corp. has opened its new research center on Grand Island, near Niagara Falls, N. Y. Located on a 61-acre site, the building provides space for about 200 personnel within its 69,000 square feet. Total cost approximates $4-million.

The center is under the direction of Chris A. Stiegman, with J. Howard Brown serving as general manager. Research will be conducted on polyesters, alkyd foams, exploratory polymers, chlorinated products, fluorinated materials, sulfur compounds, and organophosphorus materials. Design allows for doubling of size, if required at a later date.

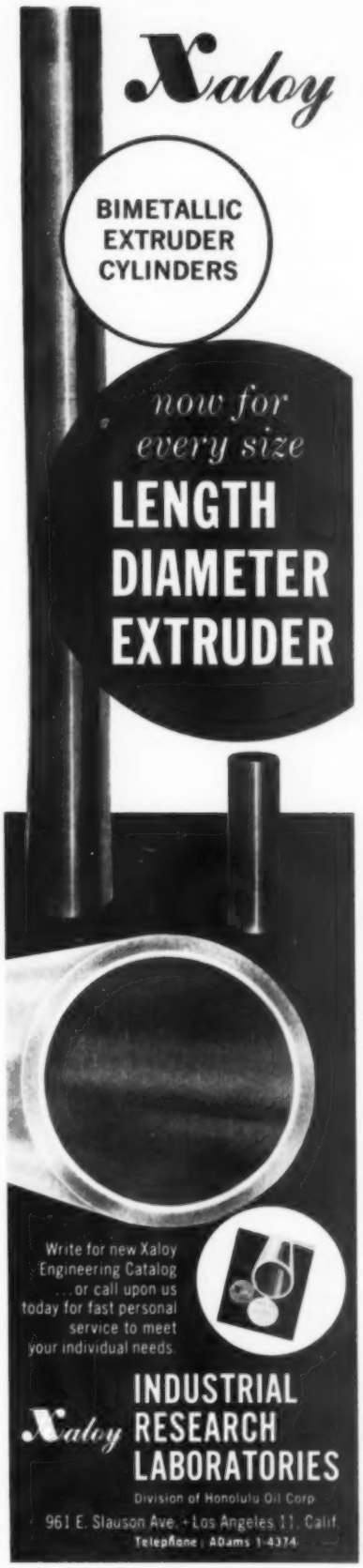
Hooker's works control laboratory will occupy the former research building laboratories, while the offices will be occupied by other departments. This relieves overcrowded conditions elsewhere in the firm. The pilot plant and process improvement divisions remain at the Niagara plant.

Union Carbide Corp. is building a plant to produce polyethylene film at Cartersville, Ga. Scheduled for completion in July of this year, the unit will be operated by **Visking Co.,** a UC division. This will be the fourth Visking plant, exclusive of the two food-casing units. When in full production, it will employ about 100 people.

American Cyanamid Co.'s plastics & resins division has opened its new development laboratory in Wallingford, Conn. A pilot plant, constructed at the same time, is also in operation. Both adjoin the plastics production facilities. The 260- by 160-foot lab is staffed by 70 chemists, engineers, and technicians who will consolidate certain of the process and product development work previously conducted in Stamford, Bound Brook, and at Wallingford.

The laboratory has six work centers for: thermosetting resins, thermoplastic resins, pilot plant, physical testing, color laboratory, and molding engineering laboratory. Operations are divided by function—bench and pilot plant; and fabrication or molding. The laboratory also will serve as a sales service center.

Extrudo-Film Corp. has begun construction of a second plant in Pottsville, Pa. A 50,000 square-foot facility, it will quadruple the firm's capacity for producing extruded polyethylene film, sheet, and tubing. About 200 people will be employed, beginning about May of this year. The installation will house expanded research and technical service facilities, as well as production equipment.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News from Abroad

Expansion in Spanish Plastics

Recent trade reports indicate increasing activity in the Spanish chemical and plastics industry. Several new firms are entering the field, and a number of companies, both large and small, have announced expansions.

Acetorgan, S. A., with a capital of 380,000,000 pesetas (about $7,350,000) has applied for authorization to establish a new chemical enterprise on a site yet to be determined in the province of Huesca. The company would build plants for annual production of 1,200-1,600 tons of octenol; 300-600 tons of butanol; 100-200 tons of hexanol; 500 tons of polyacrylonitrile; and 4,500 tons of acrylic fiber.

Artificial fibers will be the main products of Fibroquimica S. A., of Barcelona, which has just been formed with a capital of 10,000,000 pesetas (about $195,000).

Not long ago, polystyrene was produced in Spain for the first time by Union Quimica del Norte de Espana, S. A., Bilbao. Now, it is learned that the company is to spend 40,800,000 pesetas (about $780,000) to expand facilities at its Axpe-Erandio (Bilbao) works. Machinery is to be installed in the polystyrene section to increase annual output from the present 1,200 tons to 3,000 tons; 2,000 tons of styrene monomer, as well as 200 tons of butadiene polymer, are to be imported annually.

Facilities of S. A. Marloma, Madrid, are to be expanded to permit the manufacture of tubes and profiles from rigid plastics for conveying liquids and for electrical installations.

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Russia's Target for Plastic Cables

Total production of 680,000 tons of plastics for the cable industry in the next seven years is the target that has been set by the authorities for the Russian chemical industry, it is learned. The plastics materials are expected to replace 532,000 tons of lead, 30,000 tons of cotton yarns and 90,000 tons of rubber.

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Joint Dutch-British Company

The Algemene Kunstzijde Unie (AKU) of Arnhem, Holland, and British Industrial Plastics Ltd. are getting ready to set up a joint company in the Netherlands which will manufacture urea-formaldehyde and melamine-formaldehyde resins and molding powders. This is another instance of foreign companies collaborating as a result of the European Common Market.

Plastics Exhibition, Dusseldorf, 1959

The Plastics Exhibition, scheduled to be held in Dusseldorf, Germany, on October 17-25, 1959, bids fair to be of special interest. For the first time, it will be truly international in scope. Previous Dusseldorf plastics exhibitions had been reserved for German representation only, although in 1955, foreign manufacturers of machinery had also been invited to participate. In addition, it is expected that the six countries of the European Common Market will strive to make a particularly good showing. As early as last September, the NOWEA of Dusseldorf, which is organizing the exhibition, was able to report what seemed to be unusual response by foreign as well as German firms.

Several scientific and technological gatherings have been arranged in connection with the Exhibition. From October 12-16, 1959, an International Symposium on Macromolecules is to be held at Wiesbaden; another international symposium, this time on the Ageing of Plastics Materials, is to take place at Dusseldorf on October 19, 1959. This is to be followed on October 20-21, 1959, by the German Congress on Plastics Materials, also at Dusseldorf.

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New Polyurethane Foam Plant

A new polyurethane foam plant is to be started in Dunville, Ontario, Canada, by Pekoba Plastic Foam of Canada, a branch of Pekoba Plastic Foam of Hamburg, Germany. The company has a license from the West German firm of Ludwig Peters for embossing and printing plastic foam, and also a license from the German Metzler A.G., will produce articles for household and commercial purposes. Special equipment is to be imported from Germany. Initially, the foams will be imported also, but it is planned to manufacture them in Canada eventually.

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Desert Housing

A portable house, entirely made of plastics, has been designed by a French firm for service in the Sahara. Made to provide lodging for 2-4 persons, it is intended especially for the personnel of an oil-drilling concern. The walls are made of rigid Klegecell (cellular PVC) sandwiched between two sheets of polyester-glass fiber laminate, and the whole is mounted on what may be termed as two skis, also of polyester-glass fiber laminate. The unit is 5.20 meters long, 3.01 meters wide and 2.95 meters high. Together with its equipment, it weighs two metric tons.

polyethylene in belgium

Cobenam, S.A., is the name of a new Belgian firm which will produce polyethylene in that country. Owned jointly by **Union Carbide** and **Societe Chimique des Derives du Petrole S.A., Petrochim,** the new company has plans underway for the construction of a plant which will have an initial capacity of 30-million pounds annually. The plant site is located near Antwerp, and will receive its raw materials from the Societe Industrielle Belge des Petroles refinery. Technical know how will be Union Carbide's.

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French-Soviet Trade Agreement

France has signed a trade agreement with Soviet Russia under the terms of which she will deliver during 1960-62 plastics machinery to a value of 1,100 million francs, including extruders for producing film from polyethylene and other synthetic materials and machines for making polyethylene goods. In addition, France is to supply a variety of equipment for making synthetic fibers to a total value of 6,300-8,000 million francs. In the latter connection, it is learned that Russian investigators have produced a synthetic fiber from a modified copolymer of acrylonitrile and vinylidene chloride, known as Saniv. This fiber is claimed to have exceptional elongation capacity at high temperature, and good resistance to acids.

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Plastics M'fr. In Algeria

The production of olefin products in Algiers is planned by four important French chemical concerns. Recently, Société Algérienne d'Etudes pour la Polymérisation des Oléfines was formed in Algiers by Société Ethylène Plastique in association with Air Liquide, Pechinery, and Huiles Goudrons et Dérivés, to undertake preliminary studies in connection with the production and exploitation of polymers and copolymers of olefins, particularly ethylene and propylene.

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Shutters of PVC

A Belgian firm has patented a new type of shutter for banks, stores, warehouses, etc., as well as for private use, that is made of a specially-compounded PVC. The individual slats of the shutter are designed to grip each other so that no metal hooks or fabric tapes are needed, and are adjustable to admit light and air as required. Since the shutter is double-walled, it is claimed to provide perfect thermal insulation. The PVC used is guaranteed to have high resistance to ageing, chemicals and weather; good dimensional stability; and resistance to temperatures from at least 25° C. to more than 60° C. The shutters are said to be easy to install, to roll up, and to maintain, and are made in a choice of white and five pastel colors.

News of the Societies

SPI Reinforced Plastics Division Conference

The 14th Annual Exhibit and Conference of the SPI Reinforced Plastics Division was held on February 3-5, 1959, at the Edgewater Beach Hotel, Chicago, Ill. By scheduling triple concurrent sessions in all three morning sessions and two afternoon sessions, the Conference program was able to include nearly 80 technical, engineering and management papers. As in the past, one of the most important phases of the program was the scheduling of contact periods that permitted the registrants (approximately 1,100) to conduct business on a formal basis at definitely stipulated periods of time. In addition, a business luncheon was held each day and the Division's annual banquet, a social event that included an entertainment program, took place on Wednesday, Feb. 4th. This banquet was preceded by a reception sponsored by the materials supplier companies.

Perhaps the most outstanding feature of the entire meeting was the air of confidence displayed by everyone attending that the field of reinforced plastics can be expected to achieve great gains in acceptance and use for both consumer and industrial applications. The industry's annual market study showed that sales in 1958 reached a record high of 185,000,000 pounds, with uses for boats, construction, consumer products, transportation, aircraft and missiles accounting for 76% of the total. This represents an increase of 10% over the Division's 1957 survey. Based on a strong upswing in January sales, the industry expects sales this year to run 20-25% above the 1958 totals, raising volume to 225,000,000 pounds in 1959.

Sales strength is reported in virtually every major market for reinforced plastics. Actual sales in fiberglass-reinforced boats have been above expectations, and the outlook for the remainder of this year is very good. The transportation market, too, is ordering reinforced plastics in greater volume than anticipated, based on increased number of automobiles being assembled and greater poundage of RP per car. The gain here is noted in both RP car bodies and in pre-mix compounds for automotive components. In addition to the customary application in radomes, the aircraft field is using RP in flooring, luggage containers, commodes, and other parts. The step-up in missile production also is reflected in demand for high temperature-resistant reinforced-plastics. Demand for RP by the chemicals and petrochemicals industries is well above the expected level, as is demand for pre-mix materials.

Design Awards

An innovation this year was the awarding of special merit citations to notable products in the Exhibit. The judges making the awards were Dave Chapman, president of Dave Chapman, Inc., and Design Research, Inc.; J. W. Hauser, executive vice president, Raymond Lowey Associates, Inc.; and J. M. Sherrer, senior associate of J. O. Reinecke & Associates. The awards were made in seven categories, as follows: Consumer Products—high-impact hammers by Plumb Chemical Co.; Materials Handling—trays and tote boxes by Molded Fiber Glass Tray Co.; Military—pressure sphere made by Apex Reinforced Plastics Div., White Sewing Machine Corp.; Process and Industrial Equipment—gear block and rack assembly by Wallace & Tiernan, Inc.; Sporting Goods—bow and arrow by Parallel Plastics, Inc.; Transportation—White truck cab by Molded Fiber Glass Body Co.; and General— fog horn by Wallace & Tiernan, Inc.

From these divisional winners, the judges selected the truck cab for the Grand Merit Award. In addition, the judges gave a special Designers Award to an IBM machine housing made by Molded Fiber Glass Co.

Three special awards (plaques and pins) were made by the Division's executive committee by work "literally beyond the call of duty" in promoting the usefulness of reinforced plastics through the SPI Reinforced Plastics Division and its activities. These Awards were made to R. J. Brinkema, Firmaline Products, Inc., and a past-chairman of the Division; L. S. Meyer, consultant, also a past-chairman of the Division; and Mrs. Harriet Raymond, Celanese Corp. of America. The Awards were made without previous publicity, and were presented with due ceremony by C. E. Bacon, Owens-Corning Fiberglas Corp. and Division chairman.

Winners of the three 1958 Executive Committee Awards of the SPI were, L. to R: R. J. Brinkema, Vice-Pres. of Firmaline Prods, Inc.; Harriet Raymond, Plastics Adv. Mgr. of Celanese Corp. of America; and L. S. Meyer, consultant.

Names in the News

Charles H. Rybolt

Charles H. Rybolt has been elected vice president, chemicals division, for Wallace & Tiernan, Inc. The division manufactures organic peroxides, sebacic acid, plasticizers, and fatty acids. He joined the firm in 1941, and had been serving as director-chemicals divisions and general manager of the Lucidol division.

Jack G. Fuller has been made sales manager for Chemtrol, Lynwood, Calif., manufacturer of corrosion-resistant plastic piping. For the past 10 years, he served as senior technical sales representative for Hercules on the West Coast.

H. W. Mohrman has been appointed to the newly-created position of director of research-associated interests for Monsanto Chemical Co.'s plastics division. He is replaced as director of research by **R. J. Schatz.** Mr. Mohrman joined Monsanto in 1939; Dr. Schatz, in 1942.

W. C. Rodgers has been appointed plant manager of Tech-Art Plastics Co., Morristown, N. J. He is former works engineer of Bakelite Co. (now Union Carbide Plastics Co.), and more recently served as chief engineer of Sylvan Plastics. **William J. Woodruff** has been named sales manager, **Howard C. Luke** becomes chief engineer, and **Frank Tokes** will be tool engineer. **Edward Schmidt,** former chief engineer of Lombard Governor Co., will be mechanical engineer in charge of the tool room. **J. Harry DuBois** will be management and engineering consultant.

Clifford E. Oman has been named general manager of U. S. Industrial Chemicals Co.'s Tuscola petrochemicals plant. He joined the firm in 1951 as an area superintendent, and was serving as assistant plant manager at the time of his new appointment.

Byron R. Wardle has been appointed marketing supervisor, Plaskon resins and materials, for Allied Chemical Corp.'s plastics & coal chemicals division. His responsibilities will include coordination and development of marketing, public relations, and advertising programs. These duties were formerly handled by Robert K. White, recently named assistant director of advertising for Allied Chemical Corp.

E. R. Behnke has been appointed manager, molecular sieve products, for Linde Co., a division of Union Carbide Corp. Formerly sales manager for these products, he is now responsible for their sale, production, and technical development. Mr. Behnke will maintain headquarters in Tonawanda, N. Y.

Harry P. Donohue, Jr., has been named Eastern sales manager, non-ceramics, for Godfrey L. Cabot's minerals & chemicals division. This includes both white pigments—Wollastonite and Cab-O-Sil. **Warren M. Parsons** will serve as Western sales manager.

A. G. Hill has been appointed manager of American Cyanamid Co.'s Bound Brook plant. Dr. Hill joined Cyanamid in 1932 as a research and development chemist, and has since served as resident technical director, manager of the pharmaceutical manufacturing department, and assistant plant manager.

George J. Godfrey

George J. Godfrey has been appointed technical director of Reed Plastics Corp., manufacturer of extrusion and injection molding compounds. He will also direct the color and control laboratories. He previously served with both Celanese Corp. and Koppers Co.

Thomas B. Nantz

Thomas B. Nantz has been named vice president of manufacturing for B. F. Goodrich Chemical Co. Former general manager of plants, he succeeds **Robert D. Scott,** who was recently named vice president in charge of development. Mr. Nantz joined the firm in 1937 as a chemist, and has served in various production capacities since that time.

Former production manager, **William C. Bentinck,** has been elected vice president in charge of production for Aeromarine Plastics Corp., Sausalito, Calif. Mr. Bentinck has been associated with the firm since its inception and, before that, with Coleman Boat & Plastics Co.

George S. Laaff

George S. Laaff has been named coordinator of product research and development for General Tire & Rubber Co.'s plastics divisions, located in Cranston, R. I., Jeanette, Pa., Lawrence, Mass., and Toledo, O. On a rotational basis, other plastics divisions' research managers subsequently will be appointed to this position. Mr. Laaff joined the Bolta staff as research director in 1945, after 15 years of plastics research at General Electric Co. He will continue as manager of research and development for the Bolta Products division during his tenure as coordinator. PLASTICS TECHNOLOGY is proud to claim Mr. Laaff as a member of its editorial advisory board.

Eugene C. Carlson has been appointed technical superintendent for the new U.S.I. petrothene plant which will be completed early in 1959, at Houston, Tex. A company employe since 1952, Mr. Carlson previously served in the chemical development department. **E. P. Richards** has been made chief engineer, and **T. Howard Dantzler** becomes superintendent of operations, also for the new facility.

Names in the News (Cont'd.)

Russell M. Ewbank has been named production manager of Narmco Industries' manufacturing division. For the past 12 years, he has been associated with Rohr Aircraft Corp. **W. S. Savill** has been named vice president and technical assistant to the president, having previously served as production manager.

Carl I. Gochenour has been appointed general manager—product development, for Hooker Chemical Corp. He previously served as manager of product development—chemicals. **Thonet C. Dauphine,** former product development manager—plastics, has accepted a position in the general development department specializing in the area of economic development.

Joseph Meyer has been appointed sales representative for Auburn Plastics, Inc., and will be responsible for the New Jersey and metropolitan New York territories. Mr. Meyer has 25 years experience in the plastics industry, and formerly represented the Prolon Plastics division of Prophylactic Brush Co.

John T. Castles has been named manager of General Electric's chemical development operation. He is the former manager of the company's silicone products department. **George E. McCullough** has been appointed polycarbonate manufacturing manager, and **Leroy S. Moody** has been appointed polycarbonates engineering manager for G-E's chemical materials department. Both doctors have been with the firm's chemical development department.

John J. Parades has joined the sales staff of Geigy Industrial Chemicals, and will maintain headquarters in St. Louis, Mo. He formerly served as sales supervisor for Monsanto organic chemical division's special chemicals department, and as a member of the advertising and sales promotion staff.

Harry C. Wechsler

Harry C. Wechsler has been elected a vice president of Borden Chemical Co., and will be responsible for various plastic product developments. He also will continue as general manager of the PVC department, which is headquartered in Leominster, Mass. A Borden employe since 1955, he set up the PVC department and directed construction of the firm's first PVC manufacturing plant.

John J. Meyer

John J. Meyer has been elected executive vice president of Great American Plastics Co., Fitchburg, Mass. Mr. Meyer was formerly vice president and general manager of Independent Lock Co. and president of Keil Lock Co. The firm's chemical division produces vinyl resins, and the finished products division manufactures plastic toys and housewares.

Valentine B. Chamberlain, Jr. has been elected vice chairman of the vinyl dispersion division, SPI, at the annual meeting on January 8. Mr. Chamberlain is sales manager of the Stanley Chemical Co., East Berlin, Conn.

Arthur Read

Arthur Read has been appointed product sales manager, automotive original equipment, for General Tire & Rubber Co.'s Bolta Products division. He succeeds **Charles J. McCarthy.** Mr. Read has served with the firm for over nine years in various sales capacities, and will now be responsible for sales of both Boltaflex and **Boltaron.**

Walter H. Stanton, manager of engineering planning at Monsanto Chemical Co.'s plastics plant at Texas City, Tex., has been appointed a technologist. Previously, he was responsible for process design of the vinyl chloride monomer installation as well as the recent ethylene plant expansion.

F. E. Condo has been appointed acting department head of the newly-formed thermoplastics research department at Shell Development Co.'s research center in Emeryville, Calif. He formerly served as head of polymer and chemical applications, and has been chemist, research supervisor, and assistant department head.

OBITUARY

Donald G. Rogers

Donald G. Rogers, 66, former president of Allied Chemical's National Aniline division, died recently at Valley Hospital, Ridgewood, N. J. He had retired in 1957.

Born in Worcester, Mass., Mr. Rogers joined General Chemical Co. upon graduation from Worcester Polytechnic Institute in 1915. In 1917, he transferred to the National Aniline division becoming assistant director of research and development in 1929, general manager in 1945, and president in 1951.

Mr. Rogers was a member of ACS, the American Association for the Advancement of Science, the Chemists Club, and the Downtown Athletic Club of New York. Burial services were held at the Westside Presbyterian Church, Ridgewood, N. J., and interment was in Easton, Pa. Mr. Rogers is survived by his wife, Marie Yahraes Rogers, and three sons; William D., David W., and C. Graydon.

Grayson W. Wilcox

Grayson W. (Gay) Wilcox, sales representative for the Durez Plastics division of Hooker Chemical Corp., died suddenly in New York City at the age of 51. Inventor of the Wilcox vent plug, Mr. Wilcox had been on the Durez sales staff since 1937, and was assigned to the New York office in 1949.

During World War II, Mr. Wilcox was on loan to the War Production Board where for 2½ years he directed allocations of phenolic molding materials and controlled priority of supplies to all molders. He was a mechanical engineer and member of the SPE and SPI. He is survived by his wife, Phyllis, and a son, Grayson, Jr.

E. E. Smith

E. E. Smith, 45, sales manager and assistant secretary of Synthane Corp., Oaks, Pa., died suddenly at his home in suburban Philadelphia on January 27. He was graduated from the Sheffield Scientific School of Yale University in 1935, and served as executive officer with the U. S. Navy in the Pacific through 1946.

Mr. Smith joined Synthane in 1940, and was named sales manager in 1952. He became assistant secretary the following year. Mr. Smith was Synthane's representative to the laminating section of the National Electrical Manufacturers Association, and was chairman of the group's marketing analysis committee. He is survived by his wife, the former Katherine de Saintphalle, and two sons, Markley E. and Peter V.

New Materials

Write item numbers on Readers' Service Card (p. 89) to obtain more information.

Polyether for Polyurethane

A polyethylene glycol polyether, which can be substituted for the hydroxyl terminated polyesters used in manufacturing rigid polyurethane foams, is being marketed under the tradename Niax Triol LK-380, by Union Carbide Chemicals Co. A semi-viscous liquid, this material imparts excellent aging characteristics and reduced water sensitivity to the finished product.

Although three formulation techniques are possible, the partial or quasi-prepolymer method is preferred. In this method, a substantial excess of diisocyanate is reacted with the polyol to yield 20-35% free isocyanate groups. Advantages derived from this technique include: easier mixing of materials during foaming operation; more complete reaction of isocyanate with hydroxyl groups; improved metering of ingredients during foaming operation; and reduced exotherm while foaming.

After preparation, the quasi-prepolymer can be stored or foamed as desired. If foamed, it must be reacted with additional polyol, surfactant, catalyst, and water; the polyol being proportioned in direct proportion to the required foam-density. Foams based on Niax LK-380 can be cured at room temperature; but for optimum physical properties, a curing cycle of 30 minutes at 95° C. is recommended.

This triol must be stored indoors or in heated tanks to minimize viscosity problems. Typical values range from 50,000 centistokes at 21° C. to 75 centistokes at 100° C. Other properties include:

Volatility, %, by weight, Max.	0.2
Hydroxyl number, mg. KOH/gm. polyol*	361.9-400.1
Acid number, mg. KOH/gm., max.*	0.2
Total unsaturation, milli-equiv./gm., max.	0.04
Water at time of shipment, % by weight, max.*	0.10
Ash, % by weight, max.	0.005

*Specific hydroxyl number, acid number, and water content is supplied with each shipment.

Readers' Service Item 1

TFE-Fluorocarbon Resin

A TFE-fluorocarbon resin which makes possible the manufacture of void free moldings and very thin electrical tapes, has been made available commercially by E. I. du Pont de Nemours & Co. Designated Teflon 7, this material has been granulated to particle sizes in the 35 micron range and offers such processing advantages as lower pre-form pressures and more uniform product density. Electrical tapes as thin as one mil can be skived from cylinders of this material.

Pre-forms of unusual strength and resistance to cracking can be cold formed at room temperature under pressures of 800-5,000 psi. Subsequent sintering at 700-740° F. develops maximum strength and homogeneity. Parts can be coined for greater dimensional accuracy, or hobbed to form complex shapes.

Teflon 7 exhibits all of the physical, mechanical, and electrical properties commonly associated with TFE fluorocarbon resins. Power factor, measured over an entire spectrum ranging from 60 cycles to 3,000 megacycles, is less than 0.0003. Volume resistivity is greater than 10^{18} ohm-cm., even after prolonged soaking in water; and short time dielectric strengths range from 500-4,000 volts/mil, depending on thickness.

Readers' Service Item 2

Epoxy Conductive Cement

A 100% solids epoxy putty, having unusually low volume resistivity, has been introduced by Houghton Laboratories, Inc. Known as Hysol 6250, this putty bonds well to most materials, and is recommended for repairing printed circuits and other applications where soldering temperatures cannot be permitted.

Mixed in a 100:8 ratio with the company's Hardener C, Hysol 6250 cures in 24 hours at room temperature, or in two hours at 140° F. Volume resistivity at 25° C. is 0.01 ohm-cm., and tensile shear strength values range between 1,800-2,000 psi. when tested on one-half inch aluminum lap specimens.

Readers' Service Item 3

Polymerization Accelerator

A technical grade N,N-dimethyl-p-toluidine, which will speed up most benzoyl peroxide-catalyzed reactions conducted in non-aqueous media, has been made available in a competitive price range by Wallace A. Erickson & Co. Previously this material was manufactured only as a highly refined product whose high price limited its use to the curing of dental acrylics.

Known as Accelerator DMT, this technical grade reportedly gives considerably faster cures than either diethyl or dimethyl aniline when used in polyester-styrene resin systems. Used in relatively small amounts it will initiate the cure of epoxy resins which have been compounded with phthalic anhydride, and in larger quantities it will itself effect the cure at temperatures of approximately 200° C. Polymeric products containing this accelerator may discolor upon exposure to light. If this is undesirable, a modified grade which overcomes this tendency, is available.

Water-white in color, this product is 99% pure and is infinitely soluble in alcohol and ether. Other properties include:

Molecular weight	135.2
Boiling point, 760 mm. Hg., °C	205-206
10 mm. Hg.°C	83-85
Refractive index	1.5435-1.5436
Moisture, %	<0.05

Readers' Service Item 4

Acrylic Copolymer Resin

Poly-Tex 900, an acrylic copolymer resin solution which imparts to industrial paint finishes a higher initial color and gloss retention, as well as increased resistance to salt spray, caustics, detergents, and stains, is being marketed by Jones-Dabney Co. Weatherometer exposures, using conventional alkyd-amino standards as controls, give this material a sufficiently wide margin as to recommend its use as an exterior automotive finish.

A baking schedule of 30 minutes at 360° F. is required to obtain the full potential properties offered by this resin, although a minimum cure of 30 minutes at 325° is permitted if these are not required. Dry film thicknesses up to 1½ mils are usually all that is necessary to obtain optimum properties. Coatings thicker than this lead to pin holing and solvent popping. With the proper selection of solvents, Poly-Tex 900 finishes can be formulated for spraying, roller coating, and dipping.

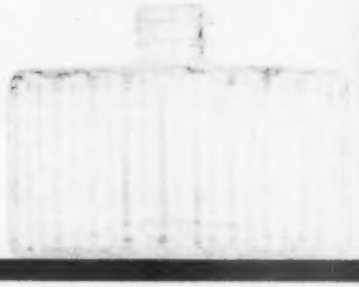
Readers' Service Item 5

Adhesive for Teflon

A high temperature-resistant adhesive for bonding sodium-etched Teflon surfaces is being marketed under the tradename Epoxylite 5403, by Epoxylite Corp. Suit-

FINEST PLASTIC CONTAINERS...

begin with Glidden Zopaque® Titanium Dioxide



The whiteness and brightness that gives bottles and other plastic containers greater eye-appeal, can best be achieved by the use of Glidden Zopaque Titanium Dioxide. Zopaque possesses outstanding optical properties — imparts high opacity, hiding power and tinting strength. And Zopaque is readily dispersible in plastic formulations.

Chances are Glidden Zopaque Titanium Dioxide can add something extra to the fine plastic products you manufacture. Write now for complete information.

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The Glidden Company
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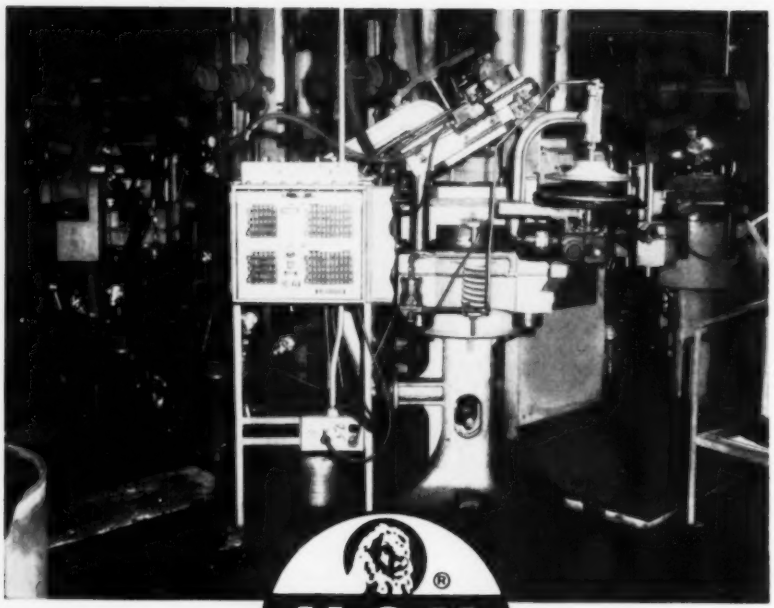


M-G-M RECORDS

M-G-M SAVES TIME

. . . and boosts production with

Taylor-Emmett ROBOTRON* Cycle Controller

In record curing, seconds saved mean dollars earned. The ROBOTRON Timer speeds up the operation because cycles can be changed so easily and quickly *from the face of the timer.* It is even possible to change curing procedures in the middle of the cycle if necessary . . . an important feature when curing procedures have to be continually adapted to the condition of the raw material. Exact repeatability of timing cycles is assured by this dependable controller.

M-G-M Records, Inc., Bloomfield, N. J., are very well satisfied with the uniformly high quality product coming off their ROBOTRON controlled presses, also the appreciable reduction in rejects.

Photograph above also shows Taylor-Emmett NEV-R-GRIND* Valves in use on steam, water and hydraulic lines to control opening and closing of the press as well as heating and cooling. NEV-R-GRIND construction means no warping, no fouling, no grinding, thanks to a new Teflon disc design that insures continued tight seating. Compact, simple design requires practically no maintenance.

• • •

For more information about Taylor-Emmett valves and timers, write Taylor-Emmett Controls, Inc., Akron, Ohio, or Taylor Instrument Companies, Rochester, New York.

*Trade-Mark

Taylor-Emmett Controls, Inc.

A SUBSIDIARY OF Taylor Instrument Companies

able for continuous use at temperatures up to 500° F., this resin also withstands short-time exposures in excess of 700° F., which is well within the temperature-resistance range of the Teflon itself.

To effect a bond, Epoxylite 5403 requires only contact pressure, and may be cured at any convenient temperature between 200-400° F. For these temperature values, cure periods range from 16 hours to 30 minutes. This adhesive is almost as chemically inert as Teflon, and has excellent electrical properties up to 400° F.

A two component system, when mixed, 5403 has a usable pot life in excess of 16 hours at room temperature, and may be kept as long as six months under refrigeration. Prior to mixing, its pot life is indefinite.

Readers' Service Item 6

Cobalt Cure for Polyesters

A cobalt curing agent for polyesters, known as 12% Cobalt Poly-Cure, is available from Mooney Chemicals, Inc. It lends a blue tint rather than red or red-brown to the resin, and exhibits a chemical activity which is claimed to be 10% better than ordinary cobalt curing agents on an equal metal basis.

A blue liquid, Cobalt Poly-Cure has minimum staining characteristics, and leaves only negligible residual odors in the finished product. Typical properties include:

Viscosity, Gardner*	A
Weight, lbs./gal.	8.44
Specific gravity*	1.013
Bulk value*	0.19
Flash point, °F	100
Volatiles, %	32

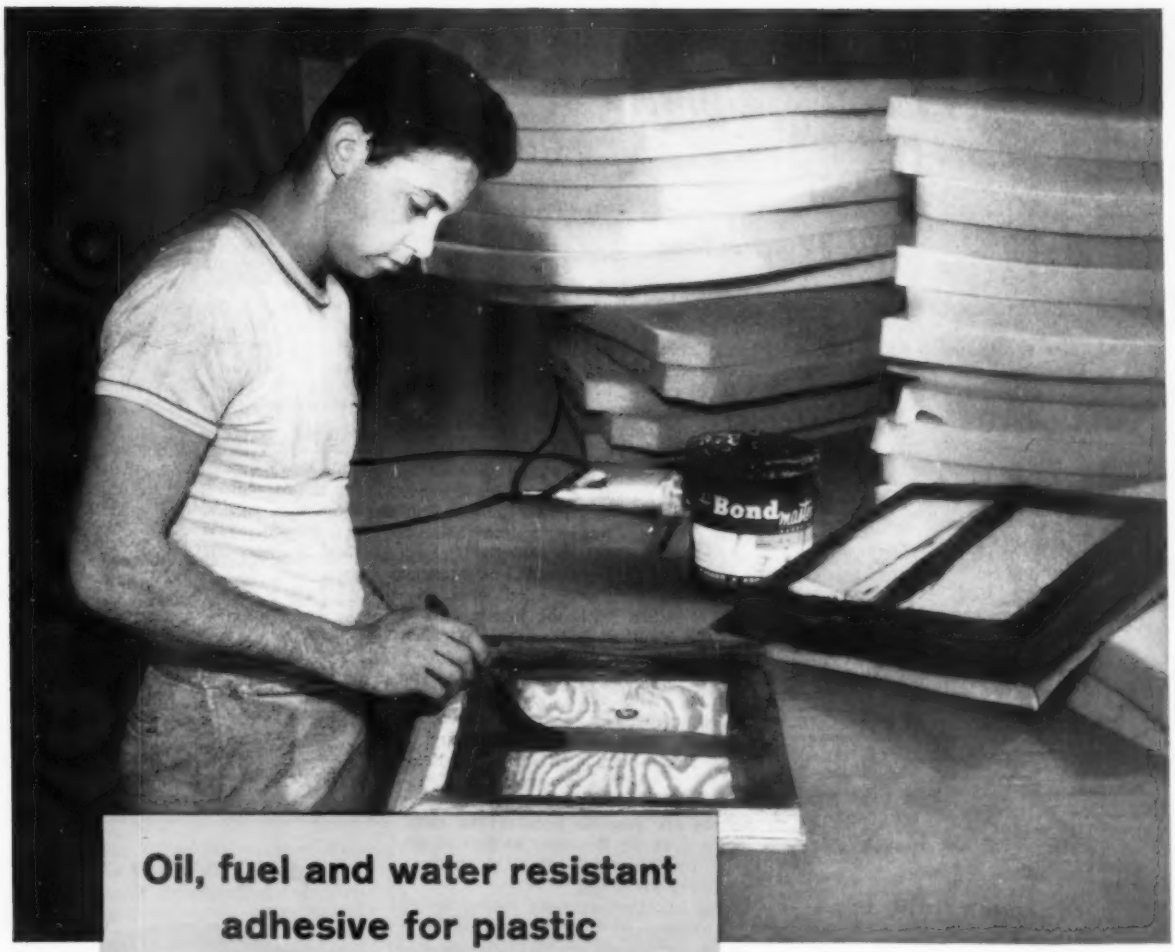
*At 77° F.

Readers' Service Item 7

Lapping Compound

Titan Tool Supply Co. is marketing an abrasive preparation for lapping and polishing dies, tools, and molds. Known as Tetrabor Paste, this preparation has a pressure resistance equivalent to diamond, and approaches it in hardness and specific weight. Grits from 100-1,200 are available in 100 gram tubes.

Readers' Service Item 8



Oil, fuel and water resistant adhesive for plastic foam made with

RCI PHENOLIC RESIN

● The Rubber and Asbestos Corporation of Bloomfield, N. J., uses a Reichhold phenolic resin as an important ingredient in the manufacture of their Bondmaster® G472 liquid adhesive.

Bondmaster G472 is a general purpose adhesive designed for bonding vinyl plastics, nitrile rubbers and cotton duck to metal, wood, concrete and other rigid surfaces.

In one application, illustrated above, the Bondmaster formulation was required to make a strong, sure bond between plastic foam and a wooden chair frame that had to withstand the rigors of marine usage. Bondmaster G472 fitted the job perfectly.

In a recent interview, an R & A formulating chemist said, "The high order of specific adhesion to the plastic foam — which makes Bondmaster the right adhesive for this job — is a direct result of the Reichhold phenolic resin."

Reichhold offers a line of phenolics especially developed for adhesive formulators. And if you're compounding adhesives, remember that RCI is also a major producer of both epoxy resins and PVAc emulsions.

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REICHHOLD RCI

REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N. Y.

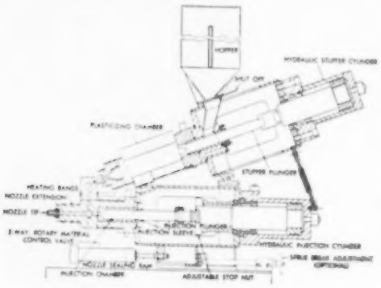
Synthetic Resins • Chemical Colors • Industrial Adhesives • Phenol • Hydrochloric Acid • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Pentachlorophenol • Sodium Pentachlorophenate • Sulfuric Acid • Methanol
Sebacic Acid • Ortho-Phenylphenol • Sodium Sulfite • Pentaerythritol

New Equipment

Write item numbers on Readers' Service Card (p. 89) to obtain more information.

Two-Stage Injection Molder

HPM 300 ounce preplasticizing injection molding machine.



Schematic view of HPM preplasticizing and injection units.

A 300-ounce injection molding machine, incorporating a preplasticizer which eliminates the stop-and-go characteristics common to conventional injection machines, is being marketed by Hydraulic Press Mfg. Co.

The preplasticizer acts in the same manner as any standard injection mechanism. Material is hopper-fed into the plasticizing chamber where it is compressed and plasticized by a stuffing plunger. From this stage, the material, now a completely homogeneous mass, pushes through a three-way rotary control valve to the injection chamber from whence it will be injected into the mold. With the exception of the injection phase, stuffing action continues throughout the entire machine cycle. This provides a constant flow of more evenly heated material than would be possible with the large, single-shot increments delivered by conventional machines.

As the plasticized material fills the "shooting" chamber, it forces the injection plunger and ram back to a positive, mechanical stop which is provided by an adjustable nut at the front end of the ram. A rotary valve mechanically shuts off at a fixed pressure, thus establishing a positive volumetric feed.

After material has been packed into the injection chamber to a predetermined pressure, the mold clamp locks and injection commences. The control valve rotates to block the passage from the preplasticizer, and simultaneously opens the nozzle. At this point, the injection ram moves forward at a controlled speed, forcing the material into the mold. It continues forward until stopped by excess pressure or until it bottoms in the injection cylinder. The cycle then repeats itself.

Combined in two integrated but easily dismantled units, the plasticizing and injection chambers are secured to their respective yokes with tapered keys. The entire assembly is mounted on phenolic shoes which slide on guided ways. Hydraulic pressure holds the nozzle against the sprue bushing and retracts it when the shot is complete.

Certain advantages attach to this type operation. Absolute shot control is achieved since the preplasticizer equalizes variations in bulk modulus occurring in pelletized and granulated materials. Pressure losses, inherent in conventional systems, are eliminated, and lower injection pressures are possible because the mold pressure is nearly the same as that at the plunger tip. This gives closer control of mold filling pressure.

Lower injection pressure means lower clamp tonnage since less separating force is exerted in the mold. Mold release improves because material is not packed in.

Because more work is done on the plastic during the preplasticizing operation, better color dispersion is achieved. This becomes more evident when dry-coloring. Cycle times are faster because the same linear plunger speed will push through larger quantities of material than are possible on standard machines. At the same time, the material can be worked at a lower average temperature which, in turn, permits shorter cure time resulting in a shorter over-all cycle. Specifications for this machine include:

Model	1500-P 300
Injection capacity, oz./cycle, max.	300
Clamp pressure, tons	1,500
Plasticizing capacity, lbs./hr.	400
Mold space, in., max.	48 x 72
Daylight opening, in.	106
Mold thickness, min. (without spacer) in.	46
Stroke, in.	60
Injection rate, in. 3/min.	6,640
Horsepower	275
Floor space, ft	36 x 12
Shipping weight, lbs	215,000

Readers' Service Item 21

Automatic Injection Molder

A four-ounce injection molding press featuring automatic, semi-automatic, or manual operation has been introduced recently by Van Dorn Iron Works Co. This machine incorporates a three-zone pyrometer heat control, and will plasticize up to 100 pounds of styrene per hour.

A double toggle lock gives sufficient leverage for a mold clamping pressure of 175 tons. The press dry-cycles 840 times per hour, and the platen stroke can be adjusted to particular jobs so that optimum cycle times can be set up in all cases.

Plunger refill stroke is adjustable for multiple stroking or filling of the heating cylinder. Hydraulic and electric safety devices are included as well as a built-in oil filter and heat exchanger for cooling hydraulic oil. A 220- or 440-volt, three-phase, 60 cycle, 15 hp.-motor acts as the prime mover; and a step-down transformer supplies 110-volt, 60-cycle current to the pyrometers, timers, and solenoids.

Other characteristics of this model include:

Van Dorn four-ounce injection press.

HAVE YOU TRIED

LOW COST MICA FLAKES For REINFORCING?

Increased electrical insulation. Compatible with all types of resins. Stocks in principal cities.

U.S. MICA CO., INC.

79 PROSPECT ST.
STAMFORD, CONN.

Volumetric capacity per shot, in.³	6.5
Casting area @ 20,000 psi. in.²	75
With starve feed, in.²	150
Injection plunger dia., in.	2
Stroke, in.	7
Pressure, max., psi.	20,000
Speed, idle, inches/min.	245
Full pressure, inches/min.	175
Cylinder dia., in.	8
Hopper capacity, lbs.	65
Mold clamping stroke, in.	4-10
Thickness, max. and min.	16-6
Size, horiz. by vert., in.	13⅜ x 23½
Platen speed, inches/sec.	0-10
Size, horiz. by vert., in.	19½ x 20⅞
Space between tie bars, horiz. by vert., in.	12⅛ x 13½
Diameter of tie bars, in.	2¾
Oil reservoir cap., gal.	80
Combined pump cap., gpm.	38.2
Machine dimensions, ft. (l x w x h)	14.51 x 4 x 6.5
Weight, approx., lbs.	7,800

Readers' Service Item 22

Automatic Vacuum Former

Single-table, drape and vacuum forming machines which also can be used for skin and blister packaging, are available in the Meteor Automatic series recently introduced by Comet Industries. These machines can form, drape, or draw to 15 inches, and will fabricate all thermoplastics from 0.001-0.156 inch in thickness.

Both oven height and clamping frame are adjustable, and extra bars and brackets are provided for the latter. An infra-red, rod-type heater is used to soften the sheet; and a cooling fan, vacuum pump, surge tank, filter, and vacuum-pressure regulator are included as standard equipment. Heating and cooling cycle timers are adjustable within a 0-120 second range, and the unit is safety-wired for two-handed operation. Other features include:

Comet Industries' Meteor Automatic.

Model No.	M-3036	M-3660	M-4872
Mold dimensions, max., in.	30 x 36	36 x 60	48 x 72
Sheet size, max. in.	32 x 38	38 x 62	50 x 74
Height (oven lowered), in.	58	58	65
Air at 80 ps., ft. 3/operation	0.5	1	2
Lift force, lbs.	720	1,300	3,000
Vacuum pump cap., cfm	9	25	40
Power requirement, volts/phase/cycles	220/3/60	220/3/60	220/3/60 440/3/60
Amperage	36	62	85
Weight, lbs.	1,200	3,000	5,000
Floor space, in.	48 x 89	72 x 90	86 x 110

Readers' Service Item 23

Hudson Bay Co.'s Weatherlab.

Environmental Cabinets

A series of high and low temperature-humidity environmental cabinets, known as Weatherlab, are being manufactured and marketed by Hudson Bay Co. The same series also is being sold under the trade-name Environ-Cab, by Hudson's parent firm, Labline, Inc.

The ovens range in size from small bench models to large, walk-in types, and are built for sustained performance at temperatures ranging from —120 to 350° F., and humidities from 20-98%. Large air blowers are used to insure even temperatures throughout the chamber. Heavy, double wall construction is used; the interiors being made of Monel metal, while the exteriors are made of stainless steel. A six-inch thick layer of Fiberglas is used as insulation.

Four operational conditions can be selected as follows: constant dry bulb with constant humidity; constant dry bulb with varying humidity; varying dry bulb and constant humidity; and varying dry bulb with varying humidity. Humidity is supplied and controlled with a water-float feed valve, and an electrically heated steam chamber or generator. The refrigeration system can be Freon-12, -22, or -13, depending on requirements.

A stainless steel control box, mounted on the right side of the cabinet, includes line switch, dual hydraulic thermostats for temperature and humidity control, pilot lights which indicate operation of heaters and compressor, as well as heater, light, and compressor switches. All electrical and electronic controls are interlocked, and reorder-controller programmers an be provided for cycling operations. Thermopane windows for the doors are available, if desired.

Readers' Service Item 24

Side-Loading Pipe-Puller

A side-loading pipe-puller which is adjustable to any plastic pipe tubing or rod between 1½-12 inches in diameter, has

RC was there...

Looks like pure magic – but it's pure science. Behind the fine performance of a plastic garden hose lies the expertness of **RC** research. Before your extrusion faces consumer use, we test and retest. And our work is not finished until your basic product incorporates those essential qualities that insure best possible product performance. **RC** Plastisols, Plasticizers, Comonomers, and Insular Vinyl Polymers and Copolymers can be utilized in a vast range of applications. We invite your inquiries for advice, technical bulletins and samples. Whether we have the final answer in stock or we come up with a modified or custom-made formula, the quality and performance of your product will prove . . . **RC** was there!

Now available: New booklets on "RC Plasticizers and Comonomers," "Insular Polymers and Copolymers."

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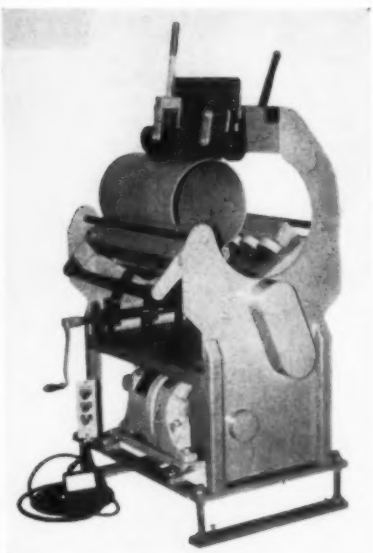
been developed by Al-Be Industries, and is being marketed in the East by the Rainville Co., Inc. Designated Model 1200-2, this unit is used in conjunction with an extruder to exert a slight "pull" on the extrudate as it leaves the die. This helps maintain close tolerances, and facilitates extrusion of thin-walled pipes and tubes.

Operating parts of the puller consist of three sets of rollers which are spaced around the pipe at 120° intervals. The pipe is supported and pulled by two sets of rollers at the bottom, and held in place by the single set at the top. The top rollers are adjusted by a single toggle lever. Each set consists of five neoprene-covered rollers, five inches in diameter and one inch wide.

The bottom rollers are individually driven by gears and timing belts connected to a one-horsepower, dual-speed, U.S. Varidrive motor. An electrical remote control, located at the extruder die, is used to vary the roller speeds from 0.9 inch per minute to 20 fpm. The motor belt linkage permits use of a single crank to adjust the driving rollers.

The top set of rollers can be adjusted to float on top of the pipe or they can be made to exert a constant pressure. At any time, the toggle lever can be thrown to lift them clear of the pipe.

Model 1200-2 is equipped with a tachometer, a remote button station, a remote speed control, and a built-in winch which is used to pull the pipe by means of a cable until the surface is even enough for the pull rolls to take hold. The unit is 60 inches high, 40 inches long, and 36 inches wide. Adjustable bolts at the base permit a four inch variation in operating height. Weight, installed, is 700 pounds.

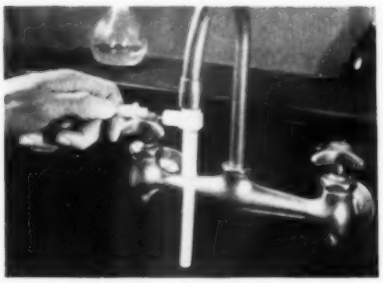


Model 1200-2 Pipe-Puller.

Readers' Service Item 25

Plastics Applications

Write item numbers on Readers' Service Card (p. 99) to obtain more information.



Polyethylene aspirator setup.

Polyethylene Aspirator Pump

A polyethylene aspirator pump which operates efficiently on all water pressures from eleven pounds up has been introduced by Fisher Scientific Co. Called the Non-Corrode, the aspirator performs all the normal functions of a metal filter pump, and will handle highly corrosive filtrates.

The Non-Corrode can be used as a vacuum suction tool for drawing up spilled acids, automatically diluting them in the process. It is also excellent for urea nitrogen tests employing the aeration method, and for cleaning pipettes and sedimentation tubes.

Non-Corrode features include an integral gum-rubber check valve and a removable, serrated hose connection on the side arm for quick disconnecting of the filter flask. This hose connector takes up to 3/8-inch tubing, since it is also tapered. Over-all height is 6¼ inches, and the male thread for faucet connection is 3/8-inch IP, the most popular size for lab faucets.

Readers' Service Item 41

Filled-Phenolic Boat Blocks

In an entirely new application for phenolics, the Mariner Co. has introduced a fabric-filled rigging block for sails up to 300 square feet. The blocks are now competitive in price with anything on the market, and volume production should cut the price to 50% that of the competition. Peerless Plastics did the molding.

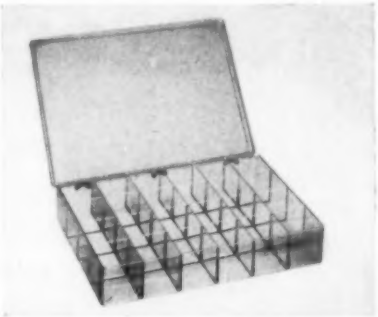
The new blocks feature stainless steel fittings, internal straps, and oilite bearings. Tough, lightweight, and resistant to water deterioration, the blocks have a minimum breaking strength of 1,750 pounds. The initial production run was 10,000 pieces.

Filled-phenolic rigging blocks.

Readers' Service Item 42

Compartmented Polystyrene Box

A 24-compartment, clear polystyrene box for nails, screws, fish hooks, washers, buttons, and the like has been injection molded by Vichek Tool Co. Called the Model P-824, the box measures 13⅛ inches long, nine inches wide, and is 2 5/16 inches deep. One of the largest of its type ever molded, the box opens and closes on three heavy-duty, heat-sealed hinges.



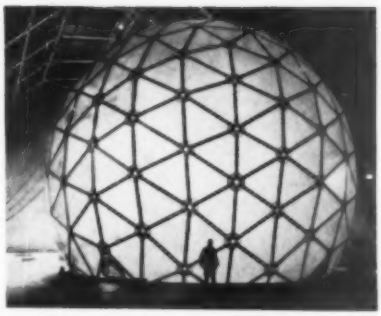
Clear styrene box has 24 compartments.

Readers' Service Item 43

World's Largest RP Radome

Goodyear Aircraft Corp. recently assembled world's largest reinforced plastic radome. Built for the missile detection systems section of General Electric's heavy military electronics department, the laminated structure stands more than seven stories high and measures 68 feet in diameter. Hundreds of interchangeable panels are bolted together in a few basic panel groups.

The giant radome can be erected or dis-assembled in approximately 80 hours, using a six-man crew. The panels weigh about 30,000 pounds, and can be shipped in eight box cars. Fire-retardant and weather resistant, the radome will withstand a 150 mph. wind.



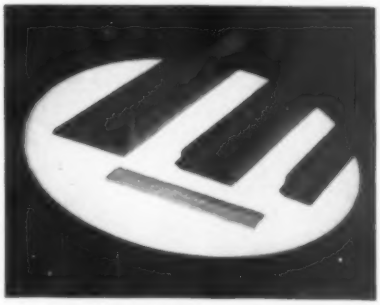
Seven-story reinforced radome.

Readers' Service Item 44

Polyester-Glass Insulators

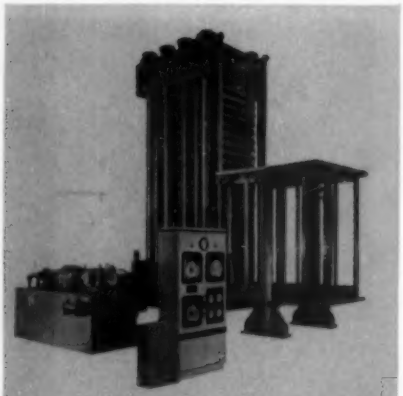
Off-the-shelf delivery of insulating structural shapes made from glass fiber-reinforced polyester is available for the first time from Glastic Corp. Shaped in both angle and channel configurations, the stock is designed for use as bus supports, tie bars, and insulating structural members in electrical apparatus operating at voltages as high as 5 KV.

Made in 14 sizes and shapes, these members can be used in Class B installations. Physical and electrical properties meet NEMA GPO-1 specifications, and flame retardancy is recognized by Underwriter's Laboratories under reference number E 23525. The stock is molded in lengths up to 76 inches and in widths up to 9⅜ inches.



Glastic's channel and angle stock.

Readers' Service Item 45



2,000-ton R. D. Wood Hydraulic Press for laminating and polishing plastics. Press has 10—4" openings, platen size 42"x83", and is of the completely self-contained type, including pumping unit for semi-automatic control of time, pressure and temperature. Press is equipped with hydraulic loading and unloading elevator. Send for complete details of this or other R. D. Wood Presses for the plastics industry, without obligation.

The most productive plants use R. D. Wood Presses

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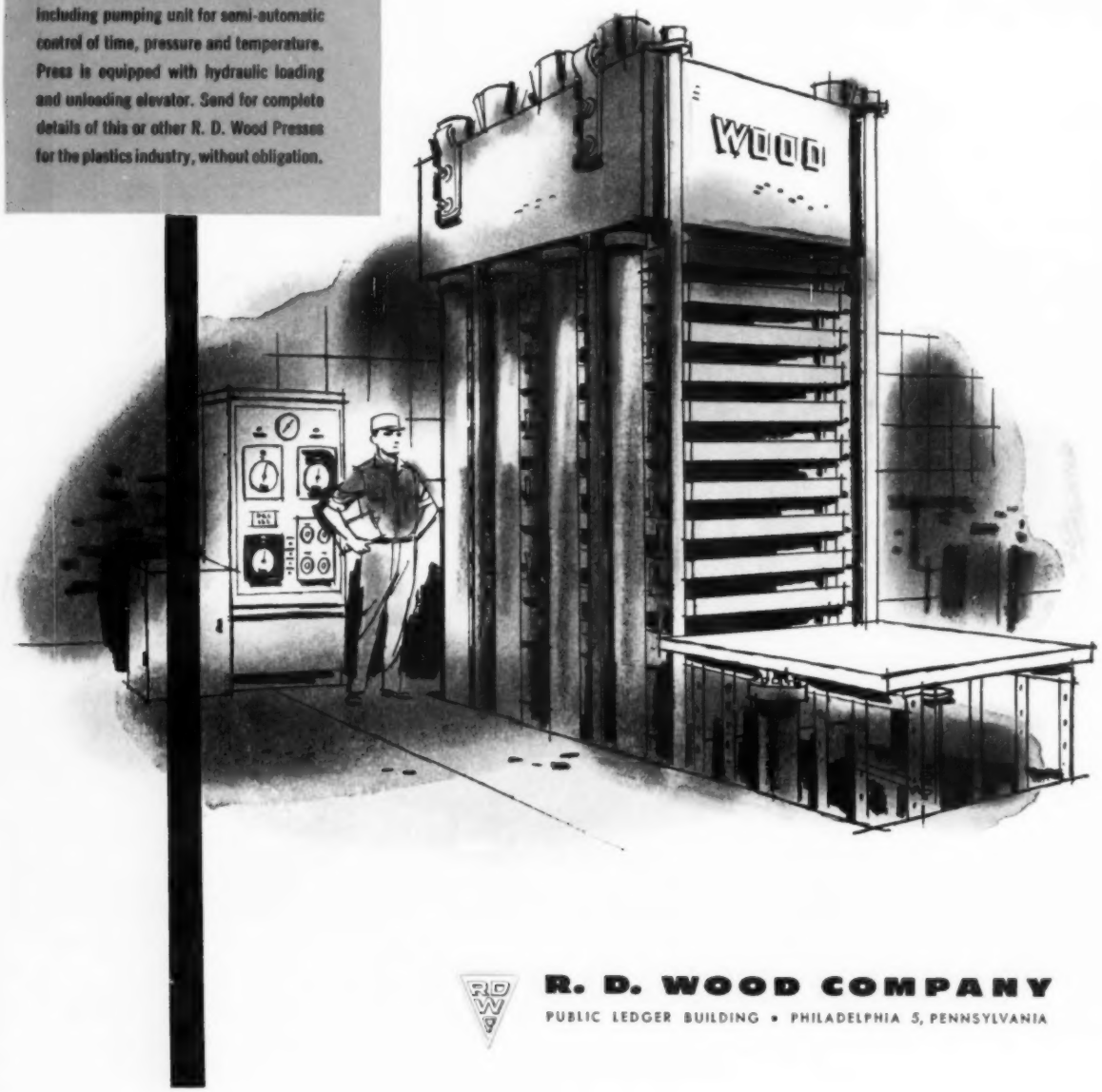

R. D. WOOD COMPANY

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Venetian 800 Series paneling.

A Touch of Old Venice

Do-it-yourself home decorators and others now have at their disposal a vinyl wall paneling which combines geometric configurations with a rosette motif to suggest the rococo decor commonly found in old Venice. Known as the Venetian 800 Series, these panels measure two by four feet and are divided, by the design, into eight major squares.

Made by Decro-Wall Corp., the 800 Series can be used to decorate ceilings, cornices, doors, and walls. Dadoes, borders, and columns are some other special effects possible. The paneling incorporates all of the grease, water, stain, and fire resistant characteristics common to the vinyls, and they can be washed and painted. Three color combinations are available: all white; white with gold accents; and black on white with gold accents.

Readers' Service Item 46

Nylon Window-Screen Clips

Molded nylon clips for holding window screens or storm window panels in place in convertible window frames have been introduced by Gries Reproducer Corp.

Molded nylon screen clips.

Possessed of a natural high elasticity, the clips give under tension to prevent noisy vibrations caused by high winds.

The clip is shaped somewhat like a miniature shoe, the heel of which is screwed to the master frame. The "sole" bears tightly against the screen-or storm window frame. Clips measure ⅞- by ½- by ⅛-inch, and the "sole" bottoms extend 1/32-inch below the "heel" surface. Other designs are available for screens which are not flush mounted.

Readers' Service Item 47

Two-Faced Go-Between

Improved laminations to open and closed cell foam materials are possible with a pressure-sensitive, translucent, film adhesive called Double-Face, which is being made and marketed by Interchemical Corp.'s Angier Adhesives division. The adhesive is a thermoplastic, reinforced

Angier's Double-Face film adhesive.

by a flexible, non-woven tissue which permits the film to conform to the contours of porous surfaces, and at the same time prevents its excessive penetration.

The film is supported for shipping and storage by a protective release paper and is sold in three different adhesive strengths —soft, medium, and firm. Double-Face provides about five mils of adhesive, the equivalent of a solution-applied coating, as opposed to the 1.5 mils per side usually found on standard double-coated tapes. Although heat, up to 200° F., is required to make laminations with porous materials, smooth surfaces can be adhered at room temperature. The film is shipped in 72 linear-yard rolls with thicknesses ranging ⅛-54 inches.

Readers' Service Item 48

Kralastic pump impeller.

Plastic Pump Impellers

Kralastic, a resin-rubber combination produced by United States Rubber Co.'s Naugatuck Chemical division, is being used to replace cast bronze in the impellers of an economy line of pumps manufactured by Barnes Mfg. Co. Impervious to temperature change and corrosion, the plastic material is fabricated more easily to close tolerances than is bronze.

The Kralastic parts are injection molded by Portage Plastics, and their smoother surfaces facilitate water passage thus contributing to higher operating efficiencies. Although tooling costs are high, volume production of these impellers negates this disadvantage.

Readers' Service Item 49

Hexagonal Molded-Nylon Nuts

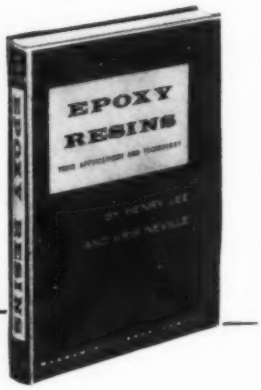
Ten sizes of hexagonal nuts have been to Gries Reproducer Corp.'s line of molded nylon fasteners: No. 2 through 5/16-inch

Hexagonal nuts molded from nylon.

The versatile EPOXY RESINS! . . .

How they work—strong and weak points—how to use them in industry

Materials and processes, properties, handling methods—the whole range of information needed to make effective industrial use of epoxy resins is covered concisely and soundly in this book. Applications in industrial castings, surface coatings, high-strength adhesives, durable laminates, solders, lightweight foams, and potting compounds are covered, against a background of the chemistry and technology of the basic resins and their reactions in curing. Also including many data in tabular and graphical form, the book will enable you to begin with a particular application, of specific performance requirements, and to formulate a compound that will very closely approach your needs.



Just Published

EPOXY RESINS

Their Applications and Technology

By HENRY LEE and KRIS NEVILLE

The Epoxylite Corporation

305 pages, 176 illustrations, 87 tables, $8.00

THIS book provides a comprehensive guide to the new field of epoxy resins, covering the chemistry of their preparation and their applications in industry.

The available data on the resins are brought together, and information given on their synthesis and curing mechanisms, curing agents, and the various materials used as fillers and modifiers, with emphasis on the engineering versatility, range, and potentialities of the epoxies.

In specific terms, the book discusses the industrial applications for the resin systems in a variety of cases where superior product performance may be obtained by their use.

Application techniques are discussed, handling characteristics are considered in detail, and the methods for characterizing both cured and uncured resins are presented. On the basis of the extensive tabular and graphic data included, practical formulations are developed for a number of industrially valuable compounds.

In all, here is information of the most practical sort for you, not only prepared by specialists in the field, but also reviewed, and with contributions included, by 20 other specialists in firms intimately concerned with epoxy resins.

Technical facts and working data in these 12 chapters

1. Epoxy Resins—Their Synthesis and Characterization
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—characterization of the cured resin
—cyclic aliphatic amines
—latent catalysis
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—incorporation of fillers into resin
—monofunctional flexibilizers
—casting of large or complex shapes
—selective improvement of adhesive characteristics
—heat-curing adhesive formulations
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—type of glass or cloth and its surface treatment
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—non-ester containing solution coatings
—heat-convertible curing agents
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—use of application equipment
—elimination of adverse physiological reactions

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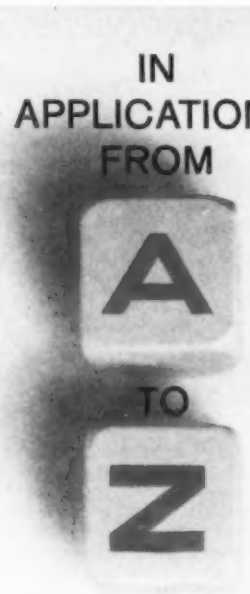

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Nuts all have a washer face and are double countersunk. They are made with a single chamfer and are standard thickness (except for the 5/16-inch sizes which are jam nuts) with unified series Class 2B threads. Nylon's high dielectric strength makes them suitable as terminal components in electronic and electrical assemblies, and eliminated the need for stocking separate insulating parts.

Readers' Service Item 50

20-foot reinfroced plastics cruiser.

Four Reinforced Plastic Boats

Lun Laminates, Inc., East Coast manufacturer and distributor of Bellingham Shipyards' Bell Boy Boats, exhibited four of the seven 1959 outboard models at the January Boat Show. Featuring one-piece hulls of fiber glass-reinforced polyester resins and a wrap-around windshield, the boats took three top awards for best design.

The 20-foot, Model 404 Express Cruiser had a lowered cabin floor for added headroom and a modified motor bracket for additional cockpit space. Hatch is on the deck. Model 265 is a 16-footer which sleeps two, has a cabin bulkhead, molded reinforced plastic motor well and cockpit paneling, handrails, and stowage compartments. The two other models are the 16-foot Bonanza and the 14-foot Bantam.

More and more people are becoming aware of the advantages of reinforced plastic craft: no maintenance, no painting, no caulking, ease of cleaning, and resistance to corrosion. The Navy now requires that all its boats of 50 feet or less be produced of these materials.

Readers' Service Item 51

New Literature

Write item numbers on Readers' Service Card (p. 89) to obtain more information.

"Taylor-Stiles 800 Series Cutters." Bulletin No. 217. Taylor, Stiles & Co. 4 pages. These machines for dicing plastics and cutting continuous filaments were formerly known as the 106 series. Operation and parts are described in detail.

Readers' Service Item 61

"Hydrite Kaolinites." TSBH-15. Georgia Kaolin Co. 12 pages. Kaolinite fractions and their effect on the physical properties of reinforced plastics are described in this bulletin. Tables and graphic data are included.

Readers' Service Item 62

"Nylon Molding Accessories." Injection Molders Supply Co. 11 pages. This is the revised 1959 edition of IMS' catalog. It contains descriptions and prices of the company's line of nozzles, ovens, annealing tanks, grinders, and mold temperature controls.

Readers' Service Item 63

"Dabco." Houdry Process Corp. Bulletin 3. 20 pages. This bulletin describes Dabco, a one-shot polyether catalyst for urethane foam production. Polyether prepolymers and dimer acid ester foams also are covered.

Readers' Service Item 64

"Isobutylene." Petro-Tex Chemical Corp. 6 pages. A 17– by 22–inch chart which graphically shows present commercial uses of isobutylene, as well as all reported reactions having potential new-product significance. Attached is a bibliography of 213 literature references.

Readers' Service Item 65

"High Pressure Acetylene Derivatives." General Aniline & Film Corp. 3 pages. This brochure outlines the properties and applications of high pressure acetylene derivatives. Structural formulas and physical descriptions of 11 of them are included.

Readers' Service Item 66

"An Introduction to Conax." Conax Corp. Bulletin 5804. 5 pages. A variety of Conax thermocouple assemblies and pressure sealing glands are described and illustrated in this brochure.

Readers' Service Item 67

"Fiberite Molding Compounds." Fiberite Corp. Bulletin 10. 4 pages. This leaflet tabulates optimum physical properties which can be found over the range of Fiberite phenolic molding compounds. An engineering information chart gives suggested molding pressures for phenolic and melamine materials when used in combination with various materials.

Readers' Service Item 68

"Sprout-Waldron Pellet Mills." Sprout, Waldron & Co., Inc. Bulletins 100-A, 165-A, 176, 182-A, 201. These 2- and 4-page bulletins illustrate and describe the company's line of laboratory and production-size pellet mills. Operational characteristics are discussed and dimensions are tabulated.

Readers' Service Item 69

"The Kemlon Pump." Keystone Engineering Co. 4 pages. Basic principles of Keystone's line of pumps for transferring corrosive fluids are described.

Readers' Service Item 70

"Gauge Saver." Sprague Engineering Corp. 2 pages. Specifications, as well as installation and adjustment details for six models of automatic shut-off valves are listed. Designed to protect gages and instruments in pneumatic and hydraulic systems, these valves are available in pressure ranges from 10-10,000 psi.

Readers' Service Item 71

"Lustrex Perma Tone Styrene." Monsanto Chemical Co. 12 pages. This booklet contains performance data and various testing techniques used to evaluate this styrene polymer. Performance curves and pertinent property values are included.

Readers' Service Item 72

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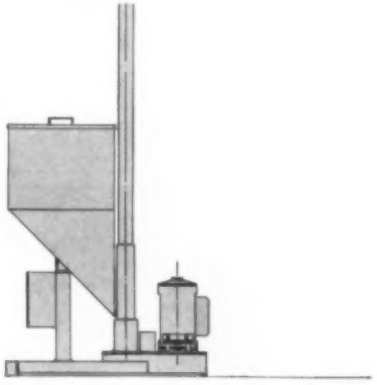

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Book Reviews

"Polyamide Resins." Donald E. Floyd. Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. Cloth, 5 by 7½ inches, 230 pages. Price, $4.50.

This book establishes a rough relationship between applications of the various polyamide resins and their respective chemical compositions and structures. Development of new resins, effect of costs in competitive fields, and development of new uses for the resins are covered in separate chapters and summarized at the end of the book.

Commencing with Carothers' work at Du Pont, the author outlines the development of the polyamides. The word nylon, a generic term, was coined to identify those resins having a molecular weight of 10,000 or greater, and the ability to form intermolecular secondary bonds. Resins with these characteristics are capable of being cold-drawn, and will form strong fibers. The nylon numbering system is explained; for example, nylon-6,10 means that the diamine contains 6 carbon atoms and the dibasic acid contains 10.

Diversity in types of polyamide resins are brought about through the choice of starting materials, degree of reaction, later modification through other chemical reactions, and alloying with other substances such as epoxies or phenolics. Manufacturing processes for four commercially-significant resins are discussed. These representative types include: nylon-6,6, from hexamethylene diamine and adipic acid; nylon-6, from caprolactam; Rilsan, from 11-amino undecanoic acid; and Versamid, from dimerized vegetable oil acids.

Molding, casting, and extrusion of nylons are discussed, as well as the multiplicity of applications to which the end-products can be put. Thermoplastic polyamides are molded under heat and pressure; while reactive, amino-containing resins can be cast into molded forms as thermoset reaction products.

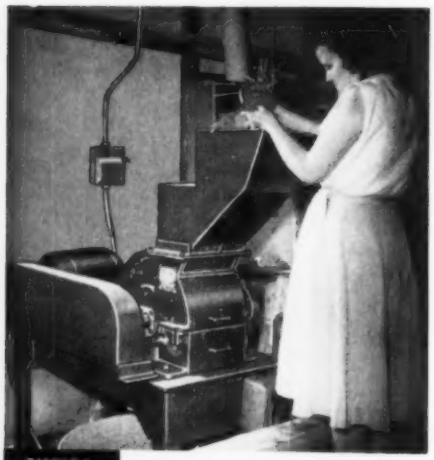
Other chapters describe the use of nylon in supported- and unsupported-film applications; as adhesives; and in water dispersions, organosols, and inks.

"Vinyl Resins." W. Mayo Smith. Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. Cloth, 5 by 7½ inches, 282 pages. Price, $5.75.

The author examines production and sales volumes of vinyl resins and presents an analysis of the several applications to which they are put. Most of the principal types are described, and considerable attention is given to polyvinyl alcohol, polyvinyl acetate, the vinyl acetals as well as the polymers and copolymers of vinyl chloride. Reported in tabular form are data describing flexible and rigid PVC, vinyl pyrrlidone-vinyl acetate copolymers, and acrylonitrile copolymers of vinyl pyrrolidone.

A detailed treatment of polymerization systems for vinyl chloride is developed in which bulk, solution, emulsion, and suspension methods are described. Vinyl chloride polymers are consumed mainly in wire and cable coatings, films, sheeting, flooring, dispersions, and coated fabric applications. Use of vinyl foams in cushioning applications is expected to increase, and it is pointed out that the paint industry consumes polyvinyl acetate in ever increasing amounts.

This book emphasizes applications of vinyl plastics and, while the author has attempted to avoid highly technical material, some detailed descriptions have been involved.



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"Extrusion of Plastics." E. G. Fisher. Interscience Publishers, Inc., 250 Park Ave., New York 1, N.Y. Cloth, 8¾ by 5½ inches, 120 pages. Price, $3.50.

This monograph covers briefly all phases of plastics extrusion, both from the practical and theoretical view-points. It is one of a series of references which are being prepared for the Plastics Institute of Great Britain and, when complete, will cover the complete range of plastics fabrication techniques and chemistry.

Although chiefly concerned with dry extrusion on screw machines, this book gives a short-form description of ram, wet, as well as pump and spinneret extrusion processes. The theory of material flow behaviour in both single- and multiple-screw extrusion machines is developed, and their operating characteristics are compared.

Separate chapters are devoted to structural features of extruders, and the materials which can be fabricated by this method. The book concludes with an over-all view of the extrusion process. This section concerns itself with die design and take-off systems, and is followed by a two-page summary of thermoset-handling.

Abstracts of Important Articles

Materials

"Toughened Polystyrene," P. Brown, *Trans. Plastics Inst.*, 26, 64, 137 (April 1958).

The physical properties of British toughened polystyrenes are compared with those of the general-purpose material, and aging, processing methods, and applications are discussed. Prices and qualities of competitive materials (polyethylene and acrylonitrils) are compared.

"The Flow Properties of Polyethylene and their Effect on Fabrication," P. L. Clegg. *Trans. Plastics Inst.*, 26, 64, 151 (April 1958).

The Melt-Flow Index gives no detailed knowledge of the flow properties of a polyethylene melt; but satisfactory characterization is possible over a wide range of pressure and out-put rates by means of a small, gas-operated, laboratory extrusion machine. This apparatus shows up two defects of the extrudate as out-put rate is increased-surface roughness (mattness), and waviness. The former depends on the flow in the die parallel to the material path, while the latter depends on the flow condition in the die-entry region. Examples of similar defects observed under commercial processing conditions are described. It is suggested that a more complete understanding of flow in polyethylene eventually may permit prediction of a given polymer's behavior under any given set of fabrication conditions.

"Plastics from Petroleum-Based Chemicals," K. C. Bryant *Trans. Plastics Ins.*, 26, 64, 174 (April 1958).

The materials discussed are polystyrene, PVC, and polyethylene. Bulk and emulsion polymerization methods, as well as polymerization with the aid of Ziegler and Natta catalysts, are described. The properties of materials obtained by different processes are compared, and applications, especially of polyethylene, are mentioned. With reference to polyethylene, the author points out that the uses for this material is developing very fast so that products in a few years will differ considerably from those now available.

"Polypropylene," G. Bier, *Kunststoffe*, 48, 8, 354 (Aug. 1958).

The properties of crystalline polypropylene, propylene polymerization reactions in general and the action of Ziegler and Natta catalysts in particular are considered. A theory of polymerization reaction is offered in which side groups take part in the reaction in its initiation and chain growth. Investigations on stereospecific contacts differing from those developed by Natta were carried out on the basis of which a method of producing polypropylene was evolved. As a result of studies on the effect of a number of variables on rate of polymerization and molecular weight, new data were obtained relating to molecular weight. The mechanical properties of polypropylene are examined briefly and compared with those of other plastics. (In German.)

"The Production of Cross-linked Plastics with Polyisocyanates in the Patent Literatures," G. Tewes, *Gummi u. Asbest*, 11, 1, 39; 11, 3, 157; 11, 4, 221; 11, 6, 354; 11, 7, 424; 11, 9, 563 (Jan., Mar., Apr., June, July and Sept. 1958).

Comprehensive review of patents relating to the production of cross-linked plastics with polyisocyanates. Foams and linear polyurethanes are not included. (In German.)

"How Plastics React Under Rapid Loading," G. R. Rugger, E. McAbee and M. Chmura, *SPE J.*, 14, 12, 31 (Dec. 1958).

Test results are given for cellulose acetate, cellulose nitrate, nylon, polystyrene, polyethylene, and other materials.

"Triazine Epoxy Resins," A. Wende and H. Priebe, *Plaste u. Kautschuk*, 4, 12, 451 (Dec. 1957).

After brief reference to the present status of epoxy resin techniques, the authors describe their own work aiming at the production of low-temperature casting and quicker-curing epoxy resins having improved thermal stability and lower flammability. This work led to the development of triazine epoxies by a method in which solvent and hydrogen halide acceptors are employed. Details are given of the preparation of these triazine epoxies, as well as of test pieces of the pure material and material reinforced with inorganic filler and fiber glass, using the triazine epoxies alone or in combination with phenol epoxy resins. Cross-linking possibilities are also discussed. (In German.)

"What's Happening in PVC Copolymers," C. D. Droman, *SPE J.*, 14, 12, 21 (Dec. 1958).

A brief survey of polyvinyl chloride-acetate copolymers made by the bulk and solution methods.

"Heat-Resistant Polyester Resins," P. Bonardi, *Poliplasti*, 6, 25, 3 (Jan.-Feb. 1958).

Recent developments on improving the thermal resistance of polyester resins are reviewed and details given of the products marketed as T.A.C., D.E.T., and HET acid. (In Italian.)

"Properties of Foamed Cold-Hardening Urea Formaldehyde," I. H. Boumann, *Kunststoffe*, 48, 8, 362 (Aug. 1958).

Results of tests on a German, open-cell foam as to shrinkage; resistance to cold, heat and chemicals; behavior under vibration; exposure to micro-organisms; sweating; thermal conductivity; and water absorption. (In German.)

"Catalyst Structure and Polymer Properties in Polyethylene Type Polymers," E. G. Curphy, *Plastics* (London), 23, 248, 189 (May 1958).

Ziegler, Natta, and supported oxide polymerizations are discussed. The structure of the catalyst and its influence on the optical configuration and properties of polymers are dealt with, and the importance of binary ratios and type of reducing agent is explained. The effect of solvents on stereospecificity also is mentioned.

Equipment

"Repairing Molds by Electroforming," W. J. B. Stokes, II, *Modern Plastics*, 36, 4, 121 (Dec. 1958).

Electrodeposition of nickel is shown to provide economical repairs for metal molds.

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in June. The last listing appeared in the February issue.

"Controlling Mold Temperatures," H. A. Meyrick, *SPE J.*, 14, 11, 33 (Nov. 1958).

Some points to better quality and higher production from molds.

"Friction in Plastics," G. Lanzavecchia, *Materie Plastiche*, 23, 11, 884 (Nov. 1957).

A rapid and simple review of the research that has been carried out on friction in macromolecular substances, referring to the literature published in Europe and America from 1929-1956. Differences between friction in metals and plastics, methods of determining friction, and the factors influencing friction (as surface condition, creep, temperature, lubricants, chemical and molecular structure fillers) are covered. (In Italian.)

"Further Developments in the Vulkollan Field," E. Muller, *Rubber & Plastics Age*, 39, 3, 195 (March 1958).

This report on recent work carried out on Vulkollans in the Main Research Laboratory of Farbenfabriken Bayer, A. G., Leverkusen, was presented at the International Synthetic Rubber Symposium held in London in March 1958. Among the recent developments discussed were a new hard type of Vulkollan with Shore hardness of 93, and stable types of Vulkollan.

Processing

"Forming Processes for Acrylic Sheet," H. Greiner, *Plaste u. Kautschuk*, 4, 10, 376, (Oct. 1957).

The processes of drawing, blowing and stretch-forming of acrylic glass sheet are examined and compared, and experience with these methods cited. Each process has its limitations as to the possibility of obtaining distortion-free, transparent products, and these are indicated. (In German.)

"New Developments in the Manufacture of Phenolic Molding Materials," E. Schneider and D. H. M. Brooks, *Trans. Plastics Inst.*, 26, 64, 117 (April 1958).

A continuous-kneading machine of Swiss design and manufacture (the Ko-Kneader) was employed for compounding in a process for producing superior phenolic molding materials. The authors describe the design of the plant and the principles of the kneading machine, and compare their methods and results with conventional methods using two-roll mills. The kneader is found to be a far more efficient mixing machine, yielding finishes at least equal to those obtained with more expensive conventional specially-formulated powders, and also gives greater uniformity of color. The process described is expected eventually to help up-grade phenolic molding materials and widen their sphere of application.

"Printing on Films," P. Absolom, *Canad. Plastics*, p. 46 (Jan. 1958).

Flexographic, gravure, and, to a lesser degree, letter-press are the main processes employed for printing plastic films for packaging. The author considers the factors involved in the application of these methods to printing various types of plastic films: including regenerated cellulose, polyethylene, photofilm, Saran, Styron and Mylar.

"More Versatile Vacuum Forming through Negative Stretch-forming," A. Riemenschneider, *Plastverarbeiter*, 11, 11, 417 (Nov. 1957).

The possibilities offered by the application of pre-stretching to vacuum deep-forming are discussed, and hints are given for successfully applying this new development in vacuum forming. The combination of negative and positive stretch-forming carried out simultaneously in the production of refrigerator door linings is illustrated. (In German.)

"Determination of Tracking Resistance by the Drop Method with Limiting Number of Drops or Limiting Stress," W. Claussnitzer and V. Siegel, *Kunststoffe*, 48, 7, 299 (July 1958).

According to German specifications VDE 0303 and DIN 53,480, tracking resistance of insulation material is tested by dripping an electrolyte of definite composition between two electrodes at 380 volts, the measure of resistance being the number of drops required to produce a short circuit. It has been suggested that determination of a minimal limiting voltage below which tracking no longer takes place, rather than the number of drops at fixed voltage, should be the criterion. Both methods, therefore, were investigated. Results tend to favor the method using the limiting drop-number; however, it is pointed out that the problem still requires a satisfactory solution (above all, the influence of boundary surface phenomena, which are connected with surface and boundary surface tension, should be studied exhaustively). (In German.)

"Creep in Polytetrafluorethylene," J. C. Millard, *Ind. Plastiques Mod.*, 10, 7, 3 (July-Aug. 1958).

Experiments were carried out with the CEMP (Plastics Research Center) rheograph to determine flow in PTFE. Details of the tests and mathematical calculations are given showing that the Boltzman principle of superimposition to represent dynamic flow does not apply to this material. The author suggests another formula with which an adequate approximation of creep behavior in PTFE is obtainable. (In French.)

"Testing Thermosetting Molding Materials for Moldability," J. T. Nye, *Trans. Plastics Inst.*, 26, 64, 82 (April 1958).

After briefly considering present trends in molding press and tool design in their relation to powder characteristics, the author discusses moldability characteristics in detail, describing a number of tests developed to assay properties more accurately and scientifically than at present. The tests, which cover cure, hardness, flow, shrinkage, pelleting properties, specific gravity, and composition of the molding material, can be applied to phenolics and all other thermosetting materials. The author states he has used them for wood- and paper-filled ureas; cellulose-, mineral- and glass-filled melamines; and cellulose- and mineral-filled alkyds, both fast and slow curing.

Applications

"Plastic Arts," J. Delorme, *Off. Matieres Plastiques*, 4, 42, 41 (Dec. 1957).

Under this punning title, the author reviews the application of plastics, including Plexiglas, Perspex, cellulose acetate, phenolics, fiberglass and polyester resins, as well as methods of producing artistic engraved novelties and plaques, sculpture, cast figures, stained-glass effects, paintings and printing. (In French.)

"Plastics Binders for Increased Foundry Efficiency," H. Kalpers, *Plastverbeiter*, 12, 12, 460 (Dec. 1957).

The use is described of German foundry core binders based respectively on urea resins and cellulose derivatives (methyl or carboxymethyl cellulose). (In German.)

"Some Applications of polyesters in the Insulation of Electrical Equipment," H. Debroise, *Pensez Plastiques*, No. 76, No. 87, 11 (Sept. & Dec. 1957).

Four forms in which polyesters are used in the insulation of components of electrical equipment are discussed: polyester-based coatings without solvent; loaded resins for filling, potting or sheathing of components; resins for bonding mica splittings and the like to paper or fiberglass supports; and finally, glass fiber-polyester laminates. Polyester coats are compared with those of other materials, and the methods of using the polyester resins and the properties of the products are described. (In French.)

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General

"Education and Research in Germany and Holland," J. E. Stucky, *Rubber & Plastics Age*, 39, 4, 278 (April 1958).

The author reports on what he saw of industrial processing, fabrication, research and education in plastics while on a tour of Germany and Holland, and compares developments there with those in Britain. The rubber and plastics factories, and special institutes visited by him are separately listed.

"Automatic Control Devices to Improve Productivity in Plastics Molding Factories," R. Kainz, *Kunststoff-Rundschau*, 4, 11, 477 (Nov. 1957).

General discussion of advantages to molders of automatic devices which aid in controlling operation costs by recording various factors involved, such as ratio of idle to working time of the presses; when the presses actually were operating; when and why they were idle; uniformity of molding procedure; start and finish of work on an order, etc. (In German.)

"Plastics Analysis and Testing in the Periodical Literature of 1956," K. D. Ledwoch and H. Meisel, *Kunststoff-Rundschau* 4, 11, 473; 4, 12, 526 (Nov. & Dec. 1957).

The authors review only the literature dealing with new analytical and testing methods, applications of known procedures in new fields, new apparatus, new standards, and test specifications. The material is divided under several heads: general analytical work concerning plastics as a whole; testing methods for thermoplastics, thermosets, natural high polymers; basic materials, adjuvants, other polymers; manufactured goods; tools and apparatus; standards and specifications. (In German.)

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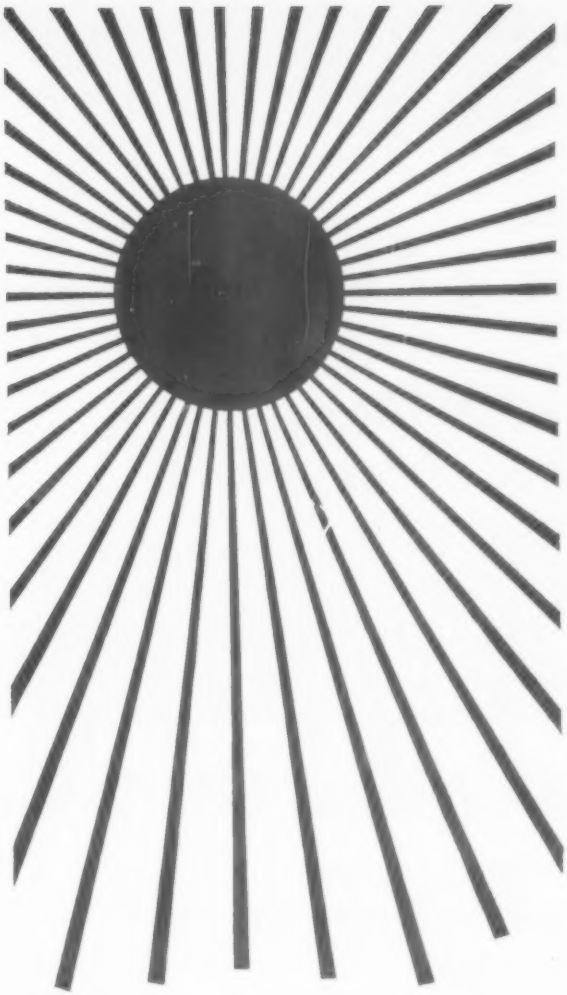

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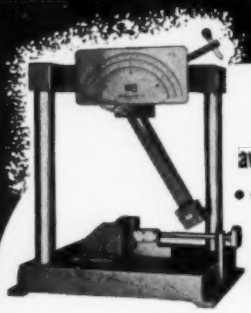

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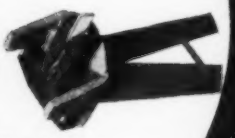

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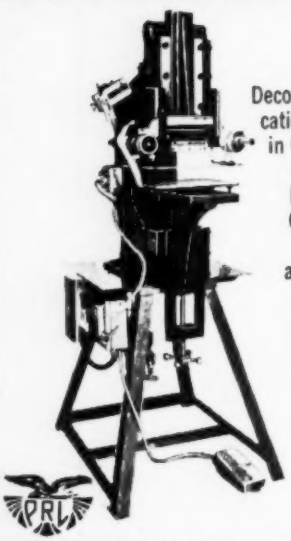

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Patent Digest

Materials

Stabilization of Mixtures of Polyamide, Epoxy Resin Solutions With Formic Acid. No. 2,844,552. David Glaser, St. Paul, Minn. (to General Mills, Inc., Minneapolis 13, Minn.).

The mixture is stabilized against gelation by means of formic acid varying from 25-100% of the quantity equivalent to the free amine groups in the polyamide resin.

Decolorization of Polyvinyl Alcohol. No. 2,844,563. Edward P. Czerwin, Niagara Falls, N.Y. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

About 0.05-0.5% by weight of formamidine sulfinic acid, based on the weight of the polyvinyl alcohol, is used as a color stabilizer.

Composition Containing Epoxy Resin, Polyvinyl Chloride, and Plasticizer. No. 2,843,557. Moyer M. Safford, Schenectady, N.Y. (to General Electric Co., Schenectady, N.Y.).

This mixture consists of: 10-40% plasticizer; 5-20% of a glycidyl polyether of a dihydric phenol which has at least two active amido hydrogens per molecule with the amide group attached directly to another carbon atom; and 50-70% of PVC.

Compositions Comprising Acrylonitrile Polymers and Diamides. No. 2,843,558. Yoshisato Fujisaki, Kochi-shi, Kochi-ken, and Hidehiko Kobayashi, Fukuokason, Ena-gun, Gifu-ken, Japan. (to Asahi Kasei Kogyo Kabushiki Kaisha, Kitaku, Osaka, Japan.).

A new composition of matter containing, in the polymer molecule, at least 85% by weight of acrylonitrile and a compound taken from the class consisting of benzoyl dimethylamide and phthaloyl tetramethylamide.

Copolymers of Vinylidene Chloride and Long-Chain Alkyl Acrylates. No. 2,843,574. E. F. Jordan, Philadelphia and W. S. Port, Norristown, Pa. (to U.S.A, Secretary of Agriculture)

The acrylate has 16-18 carbon atoms in the alkyl group and constitutes about 15-40% by weight of the copolymer.

Organic Pigments. No. 2,844,484. Albert D. Reidinger. Wilmington, Del., and William S. Struve, Chatham, N.J. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

A new red pigment which is a linear quinacridone in alpha crystal phase. It is characterized by an X-ray diffraction pattern showing two closely related strong lines with interplanar spacings of 3.46 A. and 3.19 A.; a third line of similar intensity with interplanar spacings of 14.-24 A.; two lines of moderate intensity with interplanar spacings of 6.32 A. and 7.13 A.; and two weak lines with spacings of 5.30A and 4.27A.

Preparation of Melamine. No. 2,845,-424. Franz Kaess and Erwin Rothlauf, Trostberg, Germany. (to Suddeutsche Kalkstickstoff-Werke, A.G., Trostberg Germany).

Urea is mixed with 2.5-20% by weight of guanidine and guanidine carbonate. The mixture is heated in a closed system to 400-450° C., until gas development has substantially terminated.

Polymerization Process for Producing Heavy Propylene Polymers. No. 2,843,641. Gordon E. Langlois, El Cerrito, and Paul E. Fischer, Concord, Calif. (to California Research Corp., San Francisco, Calif.).

A propylene-containing, normally-gaseous, hydrocarbon feed and a normally-liquid polymer material consisting predominately of propylene tetramer are contacted with a liquid phosphoric acid at a temperature between 175-325° F., a pressure from 200-1,800 psig., and a liquid polymer/propylene weight ratio from 3-20.

Resin Composition and Process of Preparing Same. No. 2,846,414. Alfred F. Schmutzler, East Orange, N.J. (to American Cyanamid Co., New York, N.Y.).

This material is prepared by reacting dicyandiamide with an aliphatic hydroxy nitrile, an aldehyde, and a polyhydric aliphatic alcohol.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
—The Editor

Equipment

Plastic Film Extruder. No. 2,844,846. Carl A. Kronholm, Yonkers, N.Y. (to Chester Packaging Products Corp., Yonkers, N.Y.).

This extruder has a die shaped to form plastic material into thin walled tubing. A cooling gas sleeve is arranged to receive the tubing shortly after extrusion. Pinch rolls, arranged for relative rotation about the extrudate axis, flatten the tubing. The film then passes through a winding apparatus, and emerges in roll form.

Apparatus for Measuring and Recording Thickness of Plastic Film. No. 2,843,937. Henry Hans Allen, London, England. (to British Celanese Ltd., London, England).

The mechanism moves the plastic sheet over a stationary anvil in an intermittent fashion. Each time the material stops, a movable foot from the thickness gage moves into contact with the sheet at the anvil. Geared with the advancing mechanism, a recording device notes variations in displacement of the foot from the anvil.

Collapsible Mandrel for Use in Fabricating Plastic Pipe. No. 2,845,658. Leroy H. Knibb, Chicago, Ill.

A series of hinged segments form a collapsible mandrel adapted for mounting on a cylindrical arbor which serves as a form on which the pipe is fabricated. Rigid spacer lugs are connected to the inner surfaces of the segments. The lugs have concave inner end surfaces which hug the arbor. A locking device secures the segments into position but, when unlocked, permits the mandrel to be collapsed to facilitate removal.

Injection Molding Device for Thermoplastic Materials. No. 2,842,798. Ernst Paschold, Schwelm, Westphalia, Germany. (to Gerdes & Co., Schwelm, Westphalia, Germany).

This device incorporates an ejector between the mold and injection nozzle. When the nozzle is withdrawn to its inoperative position, the ejector moves downward to shear off the sprue and at the same time close the nozzle.

Processing

Method for Making Lead-Impregnated Plastics Articles. No. 2,845,660. Alva K. Peiler, Glendora, Calif.

A finely-divided dry lead powder is aerated to a fluffy consistency and mixed

with a liquid plastic. Occluded gas is removed from the mixture by mixing it under a vacuum, following which it is molded to the desired shape.

Process for Removal of Divinylacetylene From Acrylonitrile. No. 2,846,025. Robert F. Butler, Hopewell, and Richard C. Datin, Petersburg, Va. (to Allied Chemical Corp., New York, N.Y.)

Acrylonitrile is mixed with methanol and brought into intimate contact with a vapor mixture of the same materials under substantially isothermal conditions. When they are in phase equilibrium, purified acrylonitrile is distilled from the mixture.

Non-Destructive Method of Testing Bonded Cellular Panels. No. 2,842,957. John W. Bacon, Jr., Palos Verdes Estates, Calif. (to Northrop Aircraft, Inc., Hawthorne, Calif.)

A reflective surface is applied to the skin of the panel and a removable tape is adhered to its edges to render the interior substantially air tight. An air hose is inserted through a hole in the tape to create a pressure differential between the interior and exterior. Structural weaknesses will be reflected by the panel's distortion.

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Polyethylene Films. No. 2,845,541. William Berry, Durleigh, Bridgewater, Somerset, Richard A. Rose, and Charles R. Rose, Bridgewater, Somerset, England. (to British Cellophane, Ltd., Bridgewater, England.

The surface of a solid polyethylene film is prepared to receive printing inks by subjecting one surface to an ultra-violet light intensity of at least 0.5 microwatt per square centimeter. The film is removed after total irradiation has reached 180 microwatt-seconds per square centimeter.

Wrapping of Objects or Goods in Thermoplastic Sheet Material. No. 2,842,910. John A. Reed, Glossop, England. (to Tootal Broadhurst Lee Co., Ltd., Manchester, England)

The sheet is manually-drawn lengthwise, from its supply-source, along a platform towards the operator. The object is placed on the sheet and partly covered by its end-portion. While in intimate contact with the sheet, the object is inverted by angular displacement away from the operator to form a loop which overlaps the end. The overlapping portion is heat sealed, the package is removed from the platform and severed from the rest of the sheet.

Applications

Foamed Plastic Seat and the Like. No. 2,845,997. George F. Waite, Pelham, N.Y. (to Curtiss-Wright Corp.)

A metal supporting frame is embedded in a base member composed of low density foamed plastic. The embedment such that a layer of the foamed plastic covers the metal and supports the human body with a minimum tendency to bottom on the base. A surface layer of pliant material is bonded to the foam.

Padded Material Construction for Sun Visor. No. 2,844,200. Gerhard Herr, Wuppertal-Vohwinkel, and Will O. Treber, Wuppertal-Elberfeld, Germany. (to Gebruder Happich, G.m.b.H., Wuppertal-Elberfeld, Germany).

A resilient foam plastic pad is provided with a peripheral slot which retains a wire frame member. The wire is arranged to form pocket portions, and the assembly is covered with a plastic foil.

Thermosensitive Organic Material. No. 2,846,559. Joseph Rosenberg, Erie, Pa. (to General Electric Co., Schenectady, N.Y.).

A composition of material having a high negative coefficient of thermal impedance separates two metallic conductors of an electric heating wire. This composition consists of a solid copolymer of 30-85% by weight of acrylonitrile, 15-30% of an acrylic acid ester, and up to 5% of a surface active agent.

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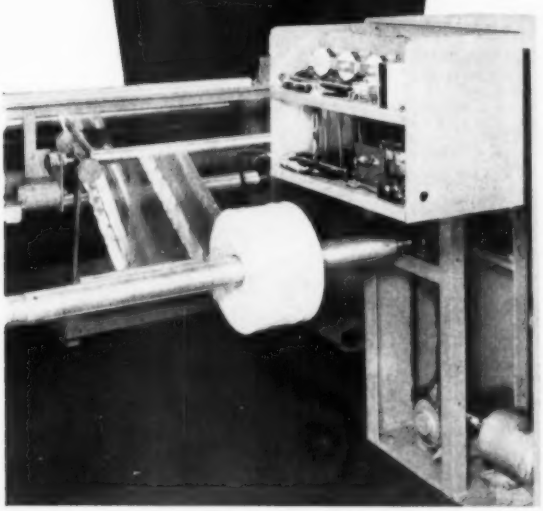

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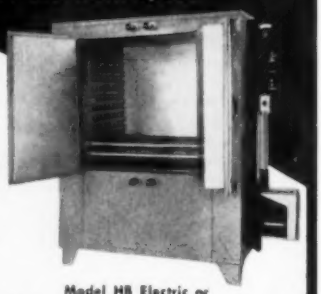

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March 26-27

SPI 16th Pacific Coast Section Conference. Hotel Del Coronado, Coronado, Calif.

April 1-2

SPE Eastern New England Section. Extrusion Workshop. Lowell Technological Institute, Lowell, Mass.

April 14-16

Toy Production Show. New York Trade Show Building, New York, N.Y.

April 20-21

SPI 17th Annual Canadian Chapter Conference. Windsor Hotel, Montreal, Can.

April 28

SPE North Texas Section RETEC. A Designer's Look At Reinforced Plastics From The Pleasure Boat, Aircraft, and Missiles Industries Viewpoint. Adolphus Hotel, Dallas, Tex.

April 29-30

Manufacturing Chemists' Association, Inc. Packaging and Transportation of Chemical Products. Engineering and Scientific Center. Cleveland, O.

May 5-22

Tokyo International Trade Fair. Plastics Hall, Tokyo, Japan.

May 7

SPE Pittsburgh Section RETEC. Plastics and the Metals Industry. Penn-Sheraton Hotel, Pittsburgh, Pa.

May 22

SPE Northern Indiana Section RETEC. Plastics in Electrical Insulation. Fort Wayne, Ind.

June 17-27

International Plastics Exhibition. British Plastics. Olympia, London, England.

June 19

SPE Detroit Section RETEC. Plastics in the Automotive Industry. Detroit, Mich.

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- separate injection and clamp hydraulic circuits
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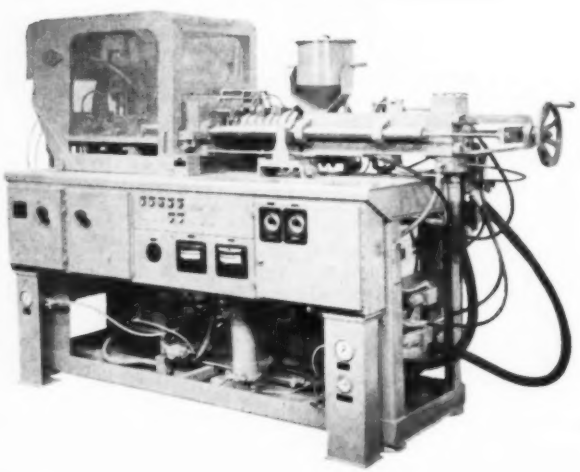
- photo electric recycling monitor
- 75 ton clamp
- 9¼" stroke
- fully automatic

*dependent on material and mold construction



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Domestic Production and Sales of Plastics and Resin Material, October and November, 1958

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of October and November, 1958. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

All plastics materials with the exception of the cellulosics which remained the same, show moderate to heavy increases over last year's figures for this period. Phenolics are up 2%, urea and melamine resins and vinyls are up 19%, styrene up 28%, coumarone up 16%, polyesters up 43%, and polyethylenes as well as the miscellaneous resins are up 25%.

	October, 1958		November, 1958	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,238,322	1,368,595	1,122,491	1,511,971
Sheets, 0.003 gage and over	1,619,819	1,640,825	1,637,495	1,676,177
All other sheets, rods, and tubes (including other cellulose plastics)	858,676	899,831	714,911	895,851
Molding and extrusion materials (including other cellulose plastics)	10,034,892	9,807,662	8,541,810	8,335,507
Nitrocellulose sheets, rods, and tubes	270,874	276,885	226,529	213,700
TOTALS	14,022,583	13,993,798	12,243,236	12,633,206
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	18,684,934	16,898,405	18,747,509	16,472,025
Bonding and adhesive resins for—				
Laminating (except plywood)	7,336,092	3,746,979	5,772,950	3,938,440
Coated and bonded abrasives	1,411,309	1,284,445	1,068,739	1,190,770
Friction materials (brake linings, clutch facings, and similar materials)[7]	1,613,084	1,316,758	1,490,599	1,279,537
Thermal insulation (fiber glass, rock wool)	4,203,023	4,394,325	3,943,550	4,002,638
Plywood	5,386,997	4,274,479	4,253,293	3,239,024
All other bonding and adhesive uses	4,149,664	4,121,678	5,029,502	4,317,828
Protective-coating resins unmodified and modified except by rosin	2,930,203	2,346,321	2,525,490	1,859,244
Resins for all other uses	3,420,098	3,678,938	3,480,226	2,963,269
TOTAL	49,135,404	42,062,328	46,311,858	39,262,775
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,464,605	3,149,543	3,348,390	2,881,772
Paper-treating and paper-coating resins	2,496,651	2,239,189	2,303,595	2,025,109
Bonding and adhesive resins for—				
Laminating	3,451,623	2,739,883	2,591,897	2,149,718
Plywood	10,440,471	10,761,970	9,395,682	8,995,583
All other bonding and adhesive uses	1,210,525	1,179,529	1,179,094	1,270,170
Protective-coating resins, straight and modified	4,020,549	2,727,930	2,849,974	2,156,211
Resins for all other uses, including molding	9,044,602	9,489,725	8,873,641	7,834,065
TOTAL	34,129,026	32,287,769	30,542,273	27,312,628
Styrene Resins:				
Molding materials[1]	43,702,699	45,711,858	48,155,731	39,490,892
Protective-coating resins, straight and modified	9,019,816	8,460,996	8,248,932	7,678,031
Resins for all other uses	15,119,966	12,308,535	14,404,743	10,734,296
TOTAL	67,842,481	66,481,389	70,809,406	57,903,219
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		7,357,973		5,760,289
Sheeting (resin content)		6,974,733		6,430,807
Molding and extrusion (resin content)		23,988,939		20,239,467
Textile and paper treating and coating (resin content)[3]		7,115,805		6,023,516
Flooring (resin content)		11,554,784		9,938,277
Protective coating (resin content)		2,528,361		2,134,308
All other uses (resin content)		8,580,297		7,227,416
All other vinyl resins for—				
Adhesives (resin content)		4,859,006		4,014,666
All other uses (resin content)		13,560,494		10,439,023
TOTAL	88,551,120	86,520,392	85,649,362	72,207,769
Coumarone-Indend and Petroleum Polymer Resins	24,105,681	24,204,742	19,635,338	18,850,853
Polyester Resins:				
For reinforced plastics	9,293,720	8,301,693	7,638,901	6,643,245
For all other uses	3,139,592	1,607,659	1,607,439	1,441,382
TOTAL	12,433,312	9,909,352	9,246,340	8,084,627
Polyethylene Resins:				
For film		30,045,499		27,628,546
For all other uses		54,084,560		44,542,333
TOTAL	79,308,587	84,130,059	78,665,600	72,170,881
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding Materials[1, 4]	5,033,274	4,859,282	5,089,358	4,372,843
Protective-coating resins[5]	2,005,854	705,429	1,887,553	687,632
Resins for all other uses[6]	14,353,192	13,093,212	13,576,986	11,645,912
TOTAL	21,392,320	18,657,923	20,553,897	16,706,387
GRAND TOTALS	390,920,514	378,247,752	373,657,310	325,132,345

[1] Includes fillers, plasticizers, and extenders.
[2] Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3] Includes data for spreader and calendering-type resins.
[4] Includes data for acrylic, nylon, silicone, and other molding materials.
[5] Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7] Included with "All other bonding and adhesives uses."
SOURCE: United States Tariff Commission, Chemical Division.

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Current Market Prices

This listing is as comprehensive and up-to-date as possible. The full listing will appear three times a year, while intervening issues will carry a briefer tabulation of price changes and additions.

Companies whose products do not appear are invited to submit price data for inclusion in the listing. All suppliers are requested to submit product additions and price changes promptly as they occur, in order to make this listing of maximum value to our readers.

Prices, in general, are f.o.b. works. Ranges indicate quantity or grade variations. No guarantee of these prices is made, and spot prices should be obtained from the individual suppliers.

—The Editor

Adhesives

Ampcoflex Adhesive	gl.	$2.75 /	$3.50
Bakelite BC—17613	lb.	.54 /	.84
BCU-40	lb.	.18 /	.48
BR-11938	lb.	.285 /	.585
Bonding resins, abrasives	lb.	.20 /	.915
Brake linings	lb.	.215 /	.6275
Foundry resins	lb.	.2075/	.395
Heat Insul. resins	lb.	.1425/	.37
CD Cement Nos. 200, 201, 202, 203, 204	gl.	.94 /	1.50
PS-7	gl.	2.12 /	2.90
Cymel 401	lb.	.43 /	.45
421	lb.	.40 /	.42
Dow Corning C-271	lb.	1.64 /	1.89
Eccobild 314	lb.	.95 /	1.20
318	lb.	1.30 /	1.75
Epon Adhesive VI, VIII	lb.	3.08 /	3.30
1X	lb.	4.25 /	4.50
Epoxy Adhesive A-1, A-3, A-4	gl.	4.45 /	6.90
A-2, A-5	gl.	5.60 /	8.00
A-6	gl.	5.80 /	8.00
C-1, C-2, C-3, C-9	gl.	5.60 /	8.00
C-4, C-7	gl.	3.69 /	5.30
Flexible Resin No. 1	gl.	4.45 /	6.90
G-E 12316	lb.	.30 /	.39
12353	lb.	.225 /	.385
Melurac 300, 302	lb.	.25 /	.29
301	lb.	.28 /	.33
Metlbond 2002-14	gl.	1.84 /	5.00
4021 Type I	sq. ft.	1.43 /	—
Type II	gl.	1.29 /	3.20
Type III	gl.	1.49 /	3.50
Plaskon Phenolic Bonding Resin	lb.	.16 /	.21
Urea Adhesive 530-11L	lb.	.1875/	.2175
Liquid Adhesive, 2L Types	lb.	.105 /	.115
WR Types	lb.	.0675/	.125
Spray Dried Adhesives	lb.	.18 /	.29
Plastic Cement	gal.	2.25 /	2.70
Pliobond 20	gal.	4.50 /	7.00
30	gal.	5.25 /	8.00
Polyester Foam Cement PC-232	gal.	2.40 /	2.90
Schenectady SP-7401	lb.	.29 /	.31
Schwartz Vinyl Cement	qt.	1.24 /	1.50
Synvarol T-3, WR 513	lb.	.0975/	.1225
T-15 D	lb.	.1275/	.1625
WR 515	lb.	.0825/	.1175
555	lb.	.0725/	.1625
Styrofoam Adhesive #5	gal.	3.75 /	4.75
Thixon CB	gal.	3.30 /	3.70
CB-2	gal.	3.75 /	3.95
IB	gal.	3.75 /	4.15
NB	gal.	4.05 /	4.45
NM-2	gal.	7.20 /	8.00
Urac 110	lb.	.205 /	.225
180	lb.	.095 /	.12
185	lb.	.1625/	.2175
186	lb.	.0875/	.1125

Anti-Static Agents

Anstac-2M	gl.	1.75 /	2.00
Hanson-Van Winkle-Munning PC-19	lb.	.322 /	.402
PC-52	lb.	.166 /	.246
PC-93	lb.	.288 /	.368
Logostat	gal.	1.35 /	1.65
Merix Anti-Static #79	qt.	.75 /	3.85
#79-OL	qt.	.75 /	3.85

Catalysts

Advance cobalt naphthenate 6%	lb.	.4825/	.5825
Cobalt tallate 6%	lb.	.4375/	.5375
Advasol	lb.	.4375/	2.5375
Aritemp Curing Agent 105	lb.	2.00 /	.25
Bakelite BH-17618	lb.	.33 /	.63
BHU-53	lb.	.15 /	.45
ERL series	lb.	.67 /	1.195
Cadet benzoyl peroxide, granules	lb.	$ .98 /	$2.00
Paste	lb.	.95 /	2.25
Powder	lb.	1.50 /	2.37
Dichlorobenzoyl peroxide	lb.	3.00 /	4.25
Lauroyl peroxide	lb.	1.90 /	3.50
Methyl ethyl ketone peroxide	lb.	1.85 /	4.00
Catalyst 57	lb.	.12	
196	lb.	.10	
C-110, -180, -180-S, C-110-S, WF-100, -101	lb.	.12	
Celanese accelerators D & E	lb.	.43 /	.50
Benzol peroxide paste	lb.	2.00	
Catalyst MC-1	lb.	2.25 /	2.50
Emerson & Cuming Catalyst 209	lb.	.95 /	4.00
211	lb.	2.25 /	4.50
217	lb.	3.40 /	4.50
Epi-Cure 82	lb.	.82 /	1.60
83	lb.	1.54 /	2.32
84	lb.	2.94 /	3.72
85	lb.	1.125 /	1.905
86	lb.	1.50 /	2.37
87	lb.	.73 /	1.51
841	lb.	1.26 /	2.04
852	lb.	.73 /	1.51
Epon Curing Agent BF_3-400	lb.	4.00 /	4.50
C-111	lb.	.6225/	1.10
D	lb.	3.33 /	4.75
T	lb.	.80 /	1.11
U	lb.	.86 /	1.02
Z	lb.	1.265 /	1.56
Linde Chemical-Loaded Molecular Sieves: CW-1015, 1115, 3010, 2013, 3120	lb.	3.00	
Lucidol Catalysts: Alperox C	lb.	1.85 /	3.50
Acetyl peroxide, 25%	lb.	1.75 /	4.00
Benzoyl peroxide, granular	lb.	.98 /	2.00
pastes	lb.	.91 /	3.00
Cyclohexanone peroxide, paste	lb.	2.25 /	2.50
Di-t-butyl diperphthalate	lb.	4.75 /	6.50
Peroxide	lb.	2.00 /	4.00
Hydroxyheptyl peroxide	lb.	4.50	
Methyl ethyl ketone peroxide	lb.	1.85 /	4.00
p-chlorobenzoyl peroxide	lb.	2.50 /	3.50
p-menthane hydro-peroxide	lb.	.545 /	2.00
t-butyl hydroperoxide	lb.	2.00 /	3.75
peracetate	lb.	4.00 /	6.00
perbenzoate	lb.	3.00 /	4.75
2, 4, dichlorobenzoyl peroxide	lb.	2.90 /	6.00
2, 5-dimethylhexane-2, 5-dihydroperoxide	lb.	5.00	
Furane H-736-A	lb.	1.30 /	2.00
Marblette Hardener 11	lb.	1.17 /	1.65
16, 661, 680	lb.	1.25 /	1.70
20	lb.	1.17 /	1.40
21	lb.	1.27 /	1.40
41, 665	lb.	1.32 /	1.77
175, 179	lb.	.50 /	.65
645H	lb.	1.15 /	1.70
681, 901	lb.	1.20 /	1.80
900, 903	lb.	2.10 /	2.50
H C Promoter 6%	lb.	.5275/	.6275
12%	lb.	.9025/	1.0025
Het anhydride	lb.	.55	
HN 531	lb.	.95 /	1.40
901	lb.	.36 /	.80
951 Ciba	lb.	.82 /	1.32
951 Furane	lb.	1.30 /	2.00
IC activators		3.00	
Inhibitor	lb.	.98	
Melurac 255, 259	lb.	.35	
Modifier CB-110, WF-61	lb.	.15	
Nuodex Benzyol peroxide 50% paste	lb.	.91 /	2.25
Benzoyl peroxide, 96%, dry	lb.	.98 /	2.00
Cobalt accelerator	lb.	.4875/	3.85
Lauroyl peroxide	lb.	1.90 /	3.50
Manganese accelerator	lb.	.2975/	2.65
M.E.K. peroxide, 60%	lb.	1.96 /	4.00
Paramenthane hydroperoxide, 54%	lb.	$0.535 /	$0.53
Silicone catalyst 1, 2	lb.	2.90 /	4.50
P-27	gal.	10.00	
Plaskon Hardeners, Liquid	lb.	.07	
Powdered	lb.	.10 /	.46
Spray dried	lb.	.10 /	.25
Promoter D-2	lb.	1.60 /	2.00
Quick-Set Accelerator 804	gal.	9.80	
Reichhold Hardeners 2600, 2601, 2602 2603, 2604	lb.	.80 /	1.58
Rezolin epoxy hardeners	lb.	1.14 /	2.50
HN-951	lb.	.86 /	1.74
SA Hardener	lb.	.10	
Sealset 701	gal.	20.00 /	22.00
702	gal.	9.20 /	10.00
703	gal.	18.00 /	19.20
Soligen	lb.	.4825/	.5825

Coating Resins

Acme 150, 160	lb.	2.00 /	2.50
Dispersant A	lb.	.75 /	1.00
Acryloids	lb.	.30 /	.87
Amberlacs	lb.	.2625/	.2875
Amberols, phenolic types	lb.	.2125/	.375
Rosin maleic types	lb.	.21 /	.345
Bakelite Phenolics	lb.	.28 /	.64
Styrene emulsions	lb.	.1375/	.31
Vinyl acetates	lb.	.295 /	.66
Solutions	gal.	5.10	
Alcohols	gal.	2.27 /	2.76
Butyral resins	lb.	1.04 /	1.24
Chlorides	lb.	.41 /	.61
Chloride-acetates	lb.	.38 /	.66
Modified	lb.	.44 /	.72
Celanese PVA emulsions, homopolymers	lb.	.17 /	.26
Copolymers	lb.	.19 /	.28
Chemigum latices	lb.	.46 /	.60
Cymel 243-3	lb.	.3675/	.3925
245-8	lb.	.3275/	.3525
247-10	lb.	.3775/	.3975
248-8	lb.	.3525/	.3775
Dow Corning 805, 808	lb.	1.54 /	1.65
806	lb.	1.85 /	1.98
840	lb.	1.52 /	1.73
Dylex K-500, -600, -700, -900	lb.	.30 /	.46
G-E 13110	lb.	.30 /	.39
Kel-F Dispersion (dry wt.)	lb.	12.00	
Ladcote FHHF-4010, FVHF-4010	lb.	.3575/	.4075
Plaskon Alkyds	lb.	.1075/	.3375
Modified	lb.	.15 /	.2625
Ester Gums	lb.	.1425/	.2475
Maleics	lb.	.1825/	.275
Melamines	lb.	.195 /	.435
Phenolics	lb.	.3925/	.475
Modified	lb.	.1825/	.29
Phenolic Laminating Varnishes	lb.	.165 /	.27
Silicone Alkyds	lb.	1.10 /	2.40
Ureas	lb.	.195 /	.435
Pieogen 2048-2	lb.	.48 /	.50
2049-1, 2050-1, 2062	lb.	.53 /	.55
2051-1	lb.	.85 /	.87
2055-2	lb.	.44 /	.46
2057-3	lb.	.73 /	.75
Pliolite latices	lb.	.30 /	.39
Pliolite N R	lb.	.93 /	1.22
S-3	lb.	.42 /	.44
S-5	lb.	.49 /	.51
Milled	lb.	.54 /	.56
S-7	lb.	.88 /	1.01
Polyfluoron liquid dispersions	lb.	2.65 /	3.85
Paste dispersions	lb.	4.20 /	4.40
Primer 140	qt.	7.88 /	8.25
Reichhold Coating Resins: Beckacite, floor covering	lb.	.2175/	.2575
Modified phenolic	lb.	.1975/	.2475
Non-phenolic	lb.	.215 /	.3175
Super, pure phenolic	lb.	.2925/	.5825
Beckamine U-F	lb.	.1975/	.35
Super, melamine	lb.	.3275/	.3975
Beckolin	lb.	.2225/	.355
Beckopol	lb.	.2525/	.2625
Beckosol Solutions, epoxy esters	lb.	.37 /	.40
Modified	lb.	.18 /	.23
Non-phthalic	lb.	.16 /	.2325
Phenolated	lb.	.16 /	.2425
Pure-drying	lb.	.1525/	.28
Non-drying	lb.	.205 /	.295
Super, isophthalic	lb.	.2075/	.3025
Epoxy resin	lb.	.595 /	.6975
Hard resin solutions	lb.	.115 /	.195
Hydrogum	lb.	.17 /	.245
Kopol	lb.	.2675/	.2725
Pentacite, non-phenolic	lb.	.17 /	.2425
Plyophen phenolics, alcohol-soluble	lb.	.17 /	.725
Liquid resins	lb.	.165 /	.20
Powdered	lb.	.30 /	.325
Solution	lb.	.2575/	.2875
Water-soluble	lb.	.111 /	.30
Resin emulsions, alkyd	lb.	.23 /	.27
Wallpol	lb.	.17 /	.23
Styresol	lb.	.2075/	.2475
Synthe-Copal	lb.	.1625/	.20
Wallkyd	lb.	.12 /	.195
Schenectady Alkyds SA Type	lb.	.3575/	.38
SE Type	lb.	.3675/	1.435
SEA Type	lb.	.3575/	.38
Styrenated	lb.	.22 /	.2625
Maleics	lb.	.1725/	.23

Phenolics	lb.	$0.2325/	$0.535
Modified	lb.	.1825/	.27
Schwartz AT-23	gl.	.63 /	1.00
BK 40	gal.	3.80 /	3.95
Versamid 100	lb.	.51 /	.69
115	lb.	.64 /	.82

Colors

Acheson 0100 Series Paste Dispersions:			
Blacks	lb.	.50 /	.81
Blues	lb.	.55 /	2.175
Green	lb.	2.51 /	2.69
Orange	lb.	.67 /	.85
Reds	lb.	1.08 /	1.34
White	lb.	.52 /	.70
Yellows	lb.	.57 /	.75
Advabrite M-10	lb.	2.25 /	2.40
Advance Brightener M.D.A.C.	lb.	12.00 /	15.00
Akron Chemical Colors:			
Dry blends, reds	lb.	1.08 /	1.23
Yellows	lb.	.58 /	.88
Organic colors, blues	lb.	.75 /	3.60
Greens	lb.	1.35 /	3.95
Reds	lb.	1.10 /	4.40
Yellows	lb.	2.00 /	5.00
Pastes, blues	lb.	1.25 /	1.58
Greens	lb.	1.85 /	1.90
Reds	lb.	1.10 /	1.40
White	lb.	.55 /	.60
Yellows	lb.	1.70 /	1.75
Argenta Pearl Essence, nat.	lb.	13.00 /	25.00
Synthetic pearl pigment	lb.	1.25 /	6.00
Cabot carbon blacks:			
Black pearls 2	lb.	.78 /	.87
71	lb.	.36 /	.44
74	lb.	.26 /	.34
81	lb.	.0975/	.17
0	lb.	.135 /	.21
Carbolac 2	lb.	.78 /	.87
Elf O	lb.	.135 /	.21
Elftex 3, 5, 8	lb.	.0825/	.145
Monarch 71	lb.	.36 /	.44
74	lb.	.26 /	.34
81	lb.	.1025/	.18
Sterling R	lb.	.0625/	.125
S	lb.	.0575/	.115
99	lb.	.0725/	.13
Supercarbovar	lb.	.53 /	.61
Cadmolith Reds	lb.	1.72 /	2.20
Yellows	lb.	1.12 /	1.20
California Ink, P. C. color dispersions:			
Black	lb.	.76 /	.77
Blues	lb.	.90 /	2.17
Brown	lb.	.56 /	.57
Green	lb.	2.05 /	2.06
Reds	lb.	.61 /	2.67
White	lb.	.72 /	.73
Yellows	lb.	.62 /	.74
P. C. plasticized boat colors:			
Black	lb.	.76 /	.77
Blue	lb.	1.32 /	1.33
Blue-green	lb.	1.21 /	1.22
Green	lb.	2.12 /	2.13
Red	lb.	2.69 /	2.70
Yellow	lb.	1.71 /	1.71
Carbic Colors:			
Permanent Carmine FBB	lb.	6.16	
Red FGR	lb.	3.07	
Yellow GR	lb.	3.50	
PV-Carmine B	lb.	5.40	
PV-Carmine HR	lb.	6.50	
PV Fast Orange GRL	lb.	27.27	
PV-Fast Red B	lb.	28.00	
PV Fast Violet BL	lb.	16.50	
PV Fast Yellow HR	lb.	5.10	
PV Orange G	lb.	3.30	
PV Red G	lb.	4.27	
PV Violet G	lb.	13.60	
PV Yellow G	lb.	4.46	
PV Yellow GG	lb.	4.00	
Claremont 4000-Series Pastes:			
Blacks	lb.	.82 /	1.01
Blue	lb.	.80	
Browns	lb.	.65 /	2.30
Greens	lb.	.80 /	2.15
Orange	lb.	1.58	
Reds	lb.	5.60 /	6.95
Silver	lb.	1.02	
White	lb.	.715	
Yellows	lb.	.65 /	2.87
D-Series pastes,			
Blacks	lb.	.48 /	.64
Blues	lb.	.62 /	1.57
Browns	lb.	.48 /	1.67
Golds	lb.	2.31 /	2.49
Green	lb.	1.78 /	1.88
Oranges	lb.	.71 /	4.27
Reds	lb.	1.10 /	6.36
Silver	lb.	.89 /	.91
Whites	lb.	.47 /	.60
Yellows	lb.	.56 /	3.70
K-Series pastes,			
Blacks	lb.	.56 /	.71
Blues	lb.	.89 /	1.40
Browns	lb.	.53 /	.55
Greens	lb.	.92 /	1.41
Metallics	lb.	.89 /	2.47
Orange	lb.	.86 /	4.45
Reds	lb.	.99 /	6.85
Violets	lb.	2.28 /	2.30
Whites	lb.	.59 /	.60
Yellows	lb.	.72 /	3.02
Maxiprint Series inks:			
Black	lb.	$0.50 /	$0.53
Blues	lb.	.68 /	1.50
Greens	lb.	.68 /	1.10
Metallics	lb.	.67 /	1.20
Orange	lb.	.71 /	.74
Red	lb.	.84 /	1.13
Violet	lb.	1.18 /	1.21
White	lb.	.51 /	.54
Yellows	lb.	.65 /	.68
MB-Series inks:			
Black	lb.	.85	
Blue	lb.	1.25	
Clears	lb.	.65 /	.66
Green	lb.	1.30	
Metallics	lb.	1.20 /	1.25
Orange	lb.	1.05	
Pearl	lb.	1.17	
Red	lb.	1.11	
White	lb.	.68	
Yellows	lb.	.90 /	1.23
MY Series inks:			
Black	lb.	.70	
Blue	lb.	1.25	
Clears	lb.	.57 /	.62
Green	lb.	1.35	
Greengold	lb.	1.90	
Orange	lb.	.85	
Pearlescent	lb.	1.95	*
Reds	lb.	1.15 /	2.95
White	lb.	.55	
Yellows	lb.	.75 /	1.35
Mylar printing inks:			
Aluminum	lb.	.99	
Black	lb.	.81	
Blue	lb.	1.18	
Bronze reducing clear	lb.	.51	
Gold concentrate	lb.	1.07	
Green	lb.	1.27	
Hi-viscosity clear	lb.	.69	
Orange	lb.	.97	
Pearlescent concentrate	lb.	1.98	
Red	lb.	1.19	
Reducing clear	lb.	.68	
White	lb.	.53	
Yellows	lb.	.83 /	1.21
PE-Series, granular concentrates:			
Blacks	lb.	.86 /	1.05
Blues	lb.	2.98	
Green	lb.	3.00	
Metallics	lb.	1.27 /	1.66
Oranges	lb.	1.12 /	2.75
Reds	lb.	1.93 /	5.25
Whites	lb.	.70 /	.85
Yellows	lb.	.78 /	5.10
PX-Series pastes:			
Blacks	lb.	1.58 /	2.15
Blues	lb.	1.15 /	2.60
Browns	lb.	1.08 /	1.47
Green	lb.	2.76 /	2.86
Grey	lb.	1.30 /	1.40
Metallic, silver	lb.	1.45 /	1.55
Orange	lb.	1.48 /	1.58
Reds	lb.	2.25 /	3.95
White	lb.	.92 /	1.02
Yellows	lb.	2.05 /	2.55
RP-Series inks:			
Aluminum	lb.	.89	
Black	lb.	.58	
Blue	lb.	1.08	
Gold	lb.	.95	
Green	lb.	1.12	
Orange	lb.	.83	
Pearlescent	lb.	1.87	
Red	lb.	1.08	
Reducing clears	lb.	.47 /	.65
White	lb.	.49	
Yellows	lb.	.71 /	1.09
UR-Series pastes:			
Black	lb.	1.00	
Blue	lb.	1.82	
Brown	lb.	2.00	
Green	lb.	2.20	
Orange	lb.	1.68	
Reds	lb.	1.92 /	3.55
White	lb.	.83	
Yellows	lb.	1.75 /	2.15
VC-Series inks:			
Black	lb.	.56	
Blue	lb.	.68 /	1.15
Clear	lb.	.39 /	.55
Green	lb.	1.155	
Metallics	lb.	.72 /	1.54
Orange	lb.	.68	
Pearl	lb.	1.96	
Red	lb.	1.17	
White	lb.	.37	
Yellows	lb.	.61	
VC-Series inks, arc resistant:			
Black	lb.	.68	
Blues	lb.	.79 /	1.05
Clears	lb.	.51 /	.53
Greens	lb.	.80 /	1.17
Metallics	lb.	.74 /	1.37
Orange	lb.	.81	
Reds	lb.	1.08	
Violet	lb.	.96	
White	lb.	.54	
Yellows	lb.	.69 /	1.15
Columbian Carbon colors:			
Aqueous dispersions			
Aquablak No. 1	lb.	.20 /	.21
3	lb.	.125 /	.135
15	lb.	.115 /	.125
26	lb.	.12 /	.13
41	lb.	.34 /	.35
B	lb.	.0975/	.1075
G	lb.	.12 /	.13
H	lb.	$0.23 /	$0.24
K	lb.	.12 /	.13
L	lb.	.14 /	.15
M	lb.	.11 /	.12
S	lb.	.12 /	.13
U	lb.	.23 /	.24
X	lb.	.11 /	.12
Coloidex No. 3	lb.	.14 /	.21
No. 8	lb.	.16 /	.23
Hiblak AE	lb.	.10 /	.11
Colloidal dispersions			
Concentateblak CQ-21	lb.	.875 /	.90
Coblak 405	lb.	.90 /	.925
DD Sol	lb.	.70 /	.725
Industrial	lb.	.73 /	.755
Coethloblak CK	lb.	1.03 /	1.055
Coresinblak No. 3	lb.	.76 /	.785
Costyreneblak 903	lb.	.595 /	.62
CJ-21	lb.	.5425/	.5675
Covarniahblak AR	lb.	.6475/	.6725
BK	lb.	.565 /	.59
BJ	lb.	.52 /	.545
Covinylblak BA	lb.	.95 /	.975
BD	lb.	.97 /	.995
BF	lb.	.70 /	.725
BH	lb.	.66 /	.685
BL	lb.	.82 /	.845
BM	lb.	.77 /	.795
CA 18	lb.	1.20 /	1.225
Cowaxblak BV-25	lb.	.515 /	.54
CB-18	lb.	.6225/	.6475
CM-83	lb.	.485 /	.51
DC Globak	lb.	.80 /	.825
DCV Coblac	lb.	.83 /	.855
Mapico colors, black	lb.	.1475/	.15
Browns	lb.	.1575/	.16
Crimsons, reds	lb.	.1425/	.145
Tans	lb.	.2325/	.235
Yellows	lb.	.12 /	.1275
Electronic Grades:			
110-2, EG-80	lb.	.1425/	.145
EG-1, EG-2	lb.	.2325/	.235
EG-3	lb.	.1575/	.16
Paint Grades			
140	lb.	.1025/	.18
999	lb.	.26 /	.34
Excelsior	lb.	.135 /	.21
Molacco	lb.	.0625/	.125
Beads	lb.	.575 /	.115
Neo Spectra MK 1	lb.	.98 /	1.07
MK 11	lb.	.78 /	.87
MK 111	lb.	.47 /	.55
Ravens 11 & 15	lb.	.1025/	.18
Royal Spectra	lb.	1.66 /	1.78
Statex	lb.	.0725/	.13
Beads	lb.	.0625/	.12
Super Spectra	lb.	.70 /	.79
Superba	lb.	.36 /	.44
Continex HAF	lb.	.0725/	.13
SRF	lb.	.0525/	.11
Cyanamid inorganic pigments:			
Cobalt blues	lb.	.28 /	.35
Chrome greens	lb.	.42 /	.44
Oranges and Yellows	lb.	.315	
Yellow 41-4576, reduced	lb.	.21	
Iron blues	lb.	.52 /	.59
Molybdate chrome oranges	lb.	.48	
Ultramarine blues	lb.	.17 /	.33
Zinc yellow	lb.	.29	
Powders, Unitane-O	lb.	.255 /	.265
Unitane-OR	lb.	.275 /	.285
Organic dyes. Indulines	lb.	.89 /	1.07
Nigrosines	lb.	.65 /	.94
Oil-soluble black	lb.	.68	
Blue	lb.	8.02	
Orange	lb.	1.06	
Reds	lb.	1.49 /	2.28
Yellows	lb.	1.21 /	4.16
Spirit-soluble black	lb.	2.95	
Brown	lb.	5.30	
Orange	lb.	5.87	
Red	lb.	6.41	
Yellows	lb.	4.62 /	4.94
Pigments, alkali blues	lb.	2.38	
Benzildine oranges	lb.	3.30	
Yellows	lb.	.69 /	3.40
Bon reds	lb.	1.50 /	2.00
Carteret red	lb.	.98	
Chlorinated para reds	lb.	1.36	
Clarion orange	lb.	1.65	
Red	lb.	1.35	
Dinitraniline oranges	lb.	1.56	
Fugitive peacock-blue lakes	lb.	1.00 /	1.27
Hansa yellows	lb.	2.20	
Lithol reds	lb.	.98 /	1.03
Methyl violet base toner	lb.	1.76	
	lb.	1.35	
Naphthol reds	lb.	.80 /	.85
Oil orange, Y-239	lb.	1.70	
Orange lakes	lb.	.85 /	.90
PTMA blue	lb.	5.55	
Greens, Lincoln	lb.	5.30 /	6.60
Violet	lb.	4.35	
Para reds	lb.	1.15 /	1.21
Phloxine toner	lb.	1.85	
Phthalocyanine blues	lb.	.90 /	3.80
Greens	lb.	3.50 /	3.95
Pigment green	lb.	1.35	
Scarlet	lb.	1.65	
Red Lake C's	lb.	1.25	
Madder	lb.	3.10	
Rhodamines	lb.	6.60	
Toluidine reds	lb.	1.70	
Yellow lakes	lb.	1.22	

Ferro inorganic colors:			
Black	lb.	$1.25 /	$1.40
Blues	lb.	1.91 /	2.96
Blue-greens	lb.	1.85 /	2.85
Browns	lb.	.90 /	1.31
Oranges	lb.	2.29 /	4.20
Pink	lb.	1.77 /	1.92
Reds	lb.	2.96 /	4.75
Violets	lb.	1.89 /	2.37
Yellows	lb.	1.26 /	2.90
Harwick Stan-Tones, blues			
Dry	lb.	.90 /	3.45
GPE	lb.	2.50 /	2.85
MBS	lb.	2.20 /	2.85
PC	lb.	1.55 /	1.92
PEC	lb.	1.95 /	2.10
Greens, dry	lb.	.82 /	3.95
GPE	lb.	1.60 /	3.00
MBS	lb.	1.15 /	3.42
PC	lb.	1.70 /	2.32
PEC	lb.	1.12 /	2.15
Oranges, cadmium dry	lb.	1.85 /	4.43
Paste	lb.	.78 /	3.08
GPE	lb.	1.20 /	1.27
MBS	lb.	1.25 /	2.82
PC	lb.	.75 /	.80
PEC	lb.	1.95 /	2.20
Reds, cadmium dry	lb.	1.97 /	5.09
Paste	lb.	3.00 /	3.63
Dry	lb.	.69 /	4.60
GPE	lb.	.77 /	3.22
MBS	lb.	1.00 /	3.15
PC	lb.	1.10 /	1.52
PEC	lb.	1.04 /	2.98
Yellows, cadmium dry	lb.	2.80 /	3.18
Paste	lb.	1.77 /	2.07
GPE	lb.	.90 /	3.32
MBS	lb.	1.30 /	2.27
PC	lb.	.55 /	3.50
PEC	lb.	2.40 /	2.65
Hiblak AE	lb.	.095 /	.10
Huber pigments:			
WVEX, EPC	lb.	.0725/	.135
Zeolex 7	lb.	.085 /	.095
23	lb.	.06 /	.07
Interchemical IC Series			
Black	lb.	.56	
Blues	lb.	.75 /	2.10
Browns	lb.	.64 /	.69
Greens	lb.	.90 /	.99
Oranges	lb.	.78 /	.89
Reds	lb.	1.16 /	2.50
White	lb.	.70	
Yellows	lb.	.95 /	1.65
Kentucky inorganics,			
Orange	lb.	.44 /	.64
Yellows	lb.	.31 /	.66
Organics	lb.	3.00 /	4.15
Greens	lb.	3.50 /	4.60
Purple	lb.	1.85 /	2.05
Reds	lb.	1.95 /	3.85
Kriegr-O Dip W Types	gl.	2.63 /	7.80
A Types	gl.	1.52 /	2.25
Laminac color pastes	lb.	.76 /	1.90
Mearlmaid Pearls	lb.	14.00 /	25.00
Nacromer Pearls, Series C	lb.	2.15 /	2.25
Series W	lb.	1.50 /	1.60
Plastics Color Co., GP colors:			
Blacks	lb.	.75 /	3.80
Blues	lb.	.445 /	.48
Brown	lb.	1.20 /	2.25
Greens	lb.	.65 /	3.50
Reds	lb.	.65 /	3.50
Whites	lb.	.75 /	1.10
Yellows	lb.	1.15 /	1.95
Dispersant 3000	lb.	.50 /	.70
3005	lb.	.40 /	.60
3007	lb.	.80 /	1.00
3008	lb.	.55 /	.75
Special acrylic pastes:			
Aqua, Ivory	lb.	1.15	
Black	lb.	1.90	
Blues	lb.	1.10 /	1.25
Brown, White	lb.	1.05	
Green	lb.	1.55	
Grey, Pink	lb.	1.25	
Red	lb.	2.45	
Yellow	lb.	1.50	
Transparent acrylic pastes:			
Amber	lb.	1.60	
Green	lb.	1.80	
Red	lb.	1.95	
Violet	lb.	2.00	
Yellow	lb.	1.50	
Pliolite S-5 bases with pigment			
Blacks	lb.	.44 /	.49
Blues	lb.	.62 /	1.48
Greens	lb.	.54 /	.58
Oranges	lb.	.61 /	.63
Reds	lb.	.31 /	1.20
Whites	lb.	.42 /	.44
Yellows	lb.	.43 /	.45
PMS polyester colors	lb.	.70 /	2.70
Polystyrene colors	lb.	.65 /	4.30
Polyester pastes, aqua	lb.	1.65	
Beige	lb.	1.45	
Black	lb.	1.10	
Blues	lb.	1.20 /	1.30
Brown	lb.	1.35	
Greens	lb.	1.20 /	1.70
Grey	lb.	1.30	
Ivory	lb.	1.30	
Oranges	lb.	1.80 /	2.05
Red	lb.	2.35	
White	lb.	.80	
Yellow	lb.	1.60	
Polysupra polyethylene			
blues	lb.	.65 /	5.60
Blacks	lb.	.50 /	.80
Browns	lb.	1.48 /	3.30
Greens	lb.	$1.82 /	$3.55
Ivory	lb.	.65 /	1.00
Purples	lb.	2.10 /	3.30
Reds	lb.	.70 /	6.30
Silver	lb.	1.50 /	2.95
White	lb.	.60 /	.83
Yellow	lb.	1.45 /	4.25
Polystyrene blues	lb.	.50 /	9.20
Blacks	lb.	.50 /	5.30
Browns	lb.	.95 /	2.55
Greens	lb.	.35 /	7.40
Ivory	lb.	.85 /	1.20
Reds	lb.	.35 /	6.40
White	lb.	.60 /	1.05
Yellows	lb.	1.45 /	2.95
R-B-H Pigment Dispersions:			
Blacks	lb.	.66 /	.84
Blues, phthalocyanines	lb.	2.74 /	2.84
Browns	lb.	.82 /	.92
Greens, chrome	lb.	.82 /	.92
Phthalocyanines	lb.	2.35 /	2.45
Orange	lb.	.83 /	.93
Red	lb.	1.88 /	1.98
Whites	lb.	.67 /	.81
Yellow	lb.	.77 /	.87
Resin Plasticizer Pastes:			
Blacks	lb.	.52 /	.695
Blue	lb.	1.65 /	1.67
Green	lb.	1.64 /	1.66
Orange	lb.	.64 /	.71
Reds	lb.	1.27 /	2.06
White	lb.	.51 /	.53
Yellows	lb.	.51 /	.59
Vinyl Extrusion Chips:			
Blacks	lb.	.895 /	1.09
Blues, iron	lb.	1.03 /	1.13
Phthalocyanine	lb.	2.45 /	2.55
Brown	lb.	.83 /	.93
Green, chrome	lb.	.91 /	1.01
Phthalocyanine	lb.	2.46 /	2.56
Oranges	lb.	.825 /	.97
Purple	lb.	3.36 /	3.46
Reds	lb.	1.605 /	1.705
White	lb.	.73 /	.83
Yellow	lb.	.795 /	.895
R-C blacks	lb.	5.50 /	21.30
Browns	lb.	4.375 /	15.75
Reds	lb.	.28 /	15.05
Yellows	lb.	3.60 /	14.05
Reichhold inorganic pigments:			
Blues, iron	lb.	.53	
Milori, pre-wet	lb.	.3625	
Greens, chrome	lb.	.42 /	.44
Reduced 25%	lb.	.19	
Oranges, chrome	lb.	.35	
Molybdate	lb.	.48	
Yellows, chrome	lb.	.33	
Zinc	lb.	.29 /	.34
Rez-N-Dye (dry wt.)	lb.	7.50	
Rona Natural Pearl Essence:			
Radiant	lb.	16.00	
Supreme	lb.	19.00	
Synthetic Pearlescent Pigments:			
100	lb.	2.25 /	2.50
200, 300	lb.	1.30 /	1.45
1000	lb.	2.05 /	2.15
1025	lb.	3.60 /	4.00
2100	lb.	3.30 /	3.45
KV	lb.	6.50	
NLV	lb.	3.40 /	3.50
RAL	lb.	2.15 /	2.45
S5	lb.	6.50	
Saran colors	lb.	.59 /	1.80
Sherwin-Williams Dispersed			
Colors	lb.	.55 /	1.97
Inorganic colors, oranges,			
yellows	lb.	.32 /	.45
Organic colors, blues	lb.	.90 /	3.60
Greens	lb.	1.35 /	3.95
Reds	lb.	.85 /	4.40
Yellows	lb.	.55 /	1.97
Vansul Organic Drys			
Blues	lb.	3.45 /	3.60
Greens	lb.	1.35 /	3.95
Oranges	lb.	2.21 /	3.00
Reds	lb.	.90 /	4.40
Yellows	lb.	2.00 /	2.25
VAP Dry Dispersions			
Black	lb.	1.00	
Blues	lb.	2.90 /	3.60
Greens	lb.	3.20 /	4.05
Oranges	lb.	1.45 /	2.55
Reds	lb.	1.70 /	4.45
Yellows	lb.	1.35 /	2.55
VP Series Pastes			
Black	lb.	.70	
Blue	lb.	1.65	
Brown	lb.	1.55	
Green	lb.	2.05	
Oranges	lb.	.80 /	2.30
Reds	lb.	1.15 /	2.55
White	lb.	.47 /	.65
Yellows	lb.	.60 /	1.65
VPE-Series Pastes			
Black	lb.	.90	
Blue	lb.	1.85	
Green	lb.	2.10	
Orange	lb.	1.00	
Reds	lb.	1.45 /	2.30
White	lb.	.90	
Yellows	lb.	1.60 /	2.00
VV Chips			
Blacks	lb.	.90 /	1.30
Blues	lb.	1.00 /	2.25
Brown	lb.	1.60	
Greens	lb.	0.90 /	2.45
Oranges	lb.	1.00 /	2.15
Reds	lb.	1.40 /	2.70
White	lb.	.65	
Yellows	lb.	.85 /	1.80
Vinylized colors, blacks,			
whites	lb.	$0.755	
Blues	lb.	1.16 /	$1.18
Golds	lb.	1.51 /	1.57
Green	lb.	1.45	
Metallic	lb.	1.15	
Orange	lb.	.83	
Reds	lb.	1.15 /	2.27
Yellows	lb.	.70 /	1.00
Violite 199, green	lb.	2.95	
200, yellow	lb.	3.75	
PL 3-60, blue	lb.	3.25	
18-70, blue	lb.	3.70	
Williams colors & pigments:			
Blacks, iron oxide	lb.	.1425/	.145
Browns, iron oxide	lb.	.1525/	.155
Burnt umbers	lb.	.0775/	.095
Greens, chromium oxide	lb.	.42 /	.4875
Reds, 100 series, 1,000			
series, RY series	lb.	.1375/	.14
Kromas	lb.	.1375/	.15
Yellows, iron oxide	lb.	.115 /	.1225
Witcoblack 12	lb.	.0725/	.14
32	lb.	.1225/	.20
50	lb.	.0975/	.175
100	lb.	.26 /	.34
Pellets	lb.	.26 /	.34
F-1	lb.	.0575/	.12
Hitone	lb.	.36 /	.44
Pellets	lb.	.36 /	.44
Zopaque, anatase	lb.	.255 /	.265
Rutile	lb.	.265 /	.285

Dispersing Agents

Darvan 1, 2, 3	lb.	.22 /	.30
7	lb.	.1875/	.2375
Dewey & Almy Daxads:			
11, 15, 23, 27	lb.	.201 /	.30
11KLS	lb.	.248 /	.35
11SPN	lb.	.1525/	.1575
21	lb.	.08 /	.20
30	lb.	.185 /	.25
Isomul extra	lb.	.30	
Tamol 731	lb.	.185 /	.1875

Fillers

Advaresin CXF	lb.	.49 /	.55
KF	lb.	.38 /	.44
A. F. D.	ton	26.50 /	60.00
Albacar 5950, 5960, 5970	ton	50.00 /	55.00
Aluminum Flake	ton	23.50 /	30.00
Anhydrous calcium sulfate			
W-1320	ton	47.00 /	52.00
Atomite	ton	32.50	
Barytes, No. 1	ton	45.00 /	65.75
Burgess Iceburg Pigment	ton	50.00	
Pigment No. 30	ton	37.00	
Cab-o-sil	lb.	.67 /	.85
Calcene NC	lb.	.036 /	.059
TM	lb.	.0375/	.0625
Camel—CARB	ton	12.00	
—TEX	ton	20.00	
—WITE	ton	32.50	
Cotton flocks	lb.	.12 /	.32
Crown Clay	ton	14.00	
Dixie Clay	ton	14.00 /	34.50
Duramite	ton	20.00	
Emerson & Cuming Filler			
BA	lb.		2.00
English Mica:			
Waterground mica 160			
mesh	lb.	.08 /	.0875
325 mesh	lb.	.0825/	.09
Georgia Kaolin clays:			
Hydrite	ton	26.00	
Flat	ton	25.00	
PD-10	ton	49.00	
PD-121	ton	20.00	
PX	ton	41.00	
Harwick fillers:			
Clays, Champion	ton	14.50 /	37.50
Harwick	ton	20.50 /	57.00
Flock, colored	lb.	.12 /	.26
white	lb.	.14 /	.28
Magnesia, tech	lb.	.055 /	.33
Magnesium carbonate	lb.	.105 /	.155
Mica, dry ground	ton	71.00 /	88.75
Mica, Silverabeen,			
160 mesh	lb.	.08 /	.0875
325 mesh	lb.	.0825/	.09
Pecan shell flour	ton	45.00 /	106.00
Silene EF	lb.	.055 /	.065
Stan White 325	ton	11.50 /	24.00
Walnut shell flours:			
100W, 200WD	ton	50.00 /	60.00
200W	ton	60.00 /	70.00
200WB	ton	62.00 /	72.00
325	ton	74.00 /	84.00
Hi-Sil 101	lb.	.10 /	.155
233	lb.	.09 /	.105
Huber Clays:			
Coating grade X-44	ton	21.00 /	26.00
Hydrasperse	ton	21.50 /	34.00
Hi-White R	ton	18.50	
Paragon	ton	14.50 /	18.50
Polyfil	ton	20.00	
Suprex	ton	14.00 /	19.00
Water-washed SWW,			
CWF	ton	12.00 /	17.00
Kalite	ton	50.00 /	65.00
Kaolloid	ton	10.50	
Laminar	lb.	.015	
Mazlite O	lb.	.2350	
Marinco C	lb.	.105 /	.13
McMamee Clay	ton	13.50 /	33.00
Minerals & Chemical Corp.:			
Edgar ASP 200	ton	43.00	

ASP 400	ton	$24.00	
ASP 600	ton	25 00	
ASP 900	ton	19 50	
ASP 1300	ton	80 00	
Multiflex MM	ton	110 00	/$125.00
Natka 1200, clay	ton	12 00	/ 35 00
Nytal 200L	ton	27 00	/ 50 00
300	ton	37 00	/ 60.00
Omya BSH	ton	45.00	
Plymouth Cordage Sisal Fibers	lb.	.1825	/ .20
Secco Clay	ton	12 00	
Silene EF	lb.	06	/ .07
Sno-Brite Clay	ton	12 50	
Snowflake	ton	20 00	
Sparmite	ton	80 00	/ 105.00
Surtex MM	ton	37 00	/ 52 00
Suspenso	ton	33 00	/ 48 00
Tamms Satin Talc	ton	22 50	/ 46 00
Velveteen R Silica	ton	23 00	/ 28 00
U.S. Mica, dry grind	lb.	04	/ .065
Witcarb F	ton	110 00	/ 140 00
R	ton	120 00	/ 150 00
Regular	ton	56 75	/ 85 00
Wollastonite F-1	ton	28 50	/ 30 50
P-1	ton	27.00	/ 29.00

Finishes

Logoquant colors	gal.	3.25	/ 6.30
Toy gloss, acetate	gal.	2.35	/ 4.30
Metal	gal.	2.45	/ 4.10
Polystyrene	gal.	2.45	/ 4.70

Flame-Proofing Agents

IC-776 Antimony Concentrate	lb.	.495	/ .51
M&T Antimony oxide	lb.	.245	/ .26

Glass Reinforcements

Chrome 60-end Roving:			
FBF 7.1, 7.3	lb.	.40	/ .44
FBF 7.5, 7.7	lb.	.42	/ .46
Garan 60-end Roving:			
FBF 7.2, 7.4	lb.	.42	/ .46
FBF 7.6, 7.8	lb.	.44	/ .48
Vitron 60-end Roving:			
VR-12	lb.	.48	/ .52

Lubricants

Advawax	lb.	.365	/ .39
Baselube	qt.	2.50	/ 4.00
Dow Corning 7 Compound	lb.	5.30	/ 6.50
20 Compound	lb.	1.74	/ 4.95
20 Emulsion	lb.	.90	/ 3.50
36 Emulsion	lb.	1.22	/ 1.40
Mold Release Fluid	lb.	3.20	/ 4.75
Emerson & Cuming Mold Release 522	lb.	9.00	/ 11 00
Garalease 915	gal.	3.80	/ 4.50
GE silicone-emulsions	lb.	1.18	/ 1.74
IC-500	gal.	2 50	
-571	gal.	3.25	
793-10	gal.	3.40	
IMS sprays, silicone, neutral oil	can	1.37	/ 2.00
Zinc stereate, dry powder	lb.	1.00	/ 2.00
Isochem wax 270	lb.	.295	
Lubrex	lb.	.27	/ .32
Lunn-Lease	gal.	3.80	/ 4.25
M 1 Mold Release	lb.	3.00	/ 4.00
Metasap barium stearate	lb.	.41	/ .46
Calcium 627	lb.	.40	/ .45
Magnesium stearate	lb.	.42	/ .47
Zinc stearate	lb.	.41	/ .46
ML-4 Separating Film	lb.	.30	/ .40
Mold-Ease Concentrate PCR	qt.	2.50	/ 5.85
Mold Release 225	gal.	5.55	/ 6.00
235	gal.	6 00	
Mold-Wiz	gal.	4.00	/ 6.00
Part-A Part	gal.	3.05	/ 3.75
Partingkote 823	qt.	1.18	/ 2.18
Prepoxy	gal.	7.20	/ 12.80
Plaskon 8406, 8407	lb.	.30	/ .37
8416 8417	lb.	.35	/ .42
8429	lb.	.40	/ .47
Poly-Lease 77	16 oz.	1.40	/ 1.50
Pleogen 3000, 3000-1	lb.	.33	/ .38
Real-Ease	20 oz.	1.10	/ 1.60
Releasor Wax No. 826	lb.	2.29	
Slide	20 oz.	1.25	/ 2.00
Sprits	20 oz.	1.00	/ 1.25
SS-452	gal.	2.80	/ 4.90
Super King Bomb-Lube	20 oz.	1.75	/ 2.50
Toplube	qt.	2.50	/ 4.00
Vibrin-VPA Parting Agent	gal.	4.25	/ 4.65

Mica

Dry Ground Mica	lb.	.04	/ .065
Mycalex 385 & 400, rods, 18 in. length		.90	/ 3.35
Sheets, 14 x 18 inches		5.70	/ 22.40
K, rods, 18-in. length		1.80	/ 6.70
Sheets, 14 x 18 inches		11.40	/ 44.80
Supramica 500, rods, 18-in. length		1.08	/ 4.02
Sheets, 14 x 18 inches		6.84	/ 26.88
Waterground Mica	lb.	.08	/ .09

Miscellaneous

Dutch Boy Bentone	lb.	.44	/ .60
Ben-A-Gel	lb.	.98	/ 1.40
IMS Two-Step Mold Surface Saver	Can	1.30	/ 2.00
Isochem Defoamer 711	lb.	.195	
Metasap Water Proofing Agent 560	lb.	$0.21	
PMS Purging Compound	lb.	.35	
Ultra violet absorber #9	lb.	5.28	/ 5.75

Plasticizers

Abcoflex A	lb.	.80	/ 2.65
B	lb.	.77	/ 2.60
C	lb.	.88	
D	lb.	.83	
Adipol 2EH, 10A XX	lb.	.40	/ .435
BCA	lb.	.43	/ .455
ODV	lb.	.43	/ .465
Admex	lb.	.3325	/ .3625
711	lb.	.3525	/ .3825
744, 745	lb.	.3925	/ .4225
760	lb.	.5725	/ .6025
761	lb.	.4425	/ .4725
562	lb.	.4825	/ .5125
Akron MP	lb.	.305	
Araldite No. 1	lb.	.765	/ 1.55
Arnold-Hoffman butyl oleate	lb.	.26	/ .27
Butyl stearate	lb.	.2275	/ .2675
Barrett dibutyl phthalate	lb.	.30	/ .335
Dimethyl phthalate	lb.	.28	/ .315
Plasticizer 136	lb.	.175	/ .21
Benzoflex 2-45	lb.	.26	/ .29
9-88	lb.	.32	/ .35
Celanese Cellulflex 21	lb.	.35	/ .375
23	lb.	.3925	/ .4175
112, 179A, 179C, 179EG, Lindol	lb.	.325	/ .36
DBP	lb.	.30	/ .335
DOP	lb.	.28	/ .315
Triphenyl phosphate	lb.	.415	/ .435
Chlorowax 40	lb.	.1525	/ .1825
50	lb.	.1675	/ .1875
70	lb.	.185	/ .25
70-S	lb.	.21	/ .275
LV	lb.	.1725	/ .2025
Columbian Carbon butyl stearate	lb.	.2525	/ .3425
Capryl alcohol	lb.	.195	/ .30
Caprylene	lb.	.10	/ .205
Dibenzyl sebacate	lb.	.91	/ 1.00
Dibutyl phthalate	lb.	.30	/ .395
Dibutyl sebacate CP	lb.	.655	/ .745
Dicapryl phthalate	lb.	.27	/ .36
Dihexyl adipate	lb.	.40	/ .495
Dihexyl phthalate	lb.	.30	/ .395
Dihexyl sebacate	lb.	.64	/ .73
Diisodecyl phthalate	lb.	.29	/ .385
Diisooctyl adipate	lb.	.40	/ .495
Diisooctyl phthalate	lb.	.28	/ .375
Dioctyl adipate	lb.	.40	/ .495
Dioctyl phthalate	lb.	.28	/ .375
Dimethyl sebacate	lb.	1.28	/ 1.37
Dioctyl sebacate	lb.	.60	/ .69
Harchemex	lb.	.24	/ .245
Harflex 300	lb.	.58	/ .675
325	lb.	.4325	/ .52
500	lb.	.315	/ .41
Isooctyldecyl phthalate	lb.	.285	/ .38
Methyl ethyl ketone	lb.	.26	/ .365
Sebacic acid, CP	lb.	.77	/ .89
Purified	lb.	.69	/ .81
Conoco H-300	lb.	.08	/ .11
Darex DIBA	lb.	.4325	/ .4675
DIBM	lb.	.305	/ .34
DIBP	lb.	.30	/ .335
DIDA, DIOA	lb.	.40	/ .435
DIDP	lb.	.29	/ .325
DIOP, DOP	lb.	.285	/ .32
DOS	lb.	.60	/ .63
Dinopol 235	lb.	.335	/ .37
IDO	lb.	.285	/ .32
MOP	lb.	.29	/ .325
Dow Plasticizer No. 5	lb.	.315	/ .54
Resin 276-V2, -V9	lb.	.265	/ .325
Drapex 3.2	lb.	.40	/ .49
Drew DP-100, DP-200	lb.	.4175	/ .46
DP-250	lb.	.4275	/ .47
DP-316	lb.	.2925	/ .335
DP-317	lb.	.555	/ .5975
DP-520	lb.	.415	/ .4575
SC	lb.	.435	
Dutch Boy Plasticizer NL-A10 (DBP)	lb.	.30	/ .33
NL-A20 (DOP), NL-A30 (DIOP)	lb.	.305	/ .335
NL-C20 (DOS)	lb.	.61	/ .63
NL F21	lb.	.395	/ .425
NL F31	lb.	.44	/ .47
NL-F41	lb.	.48	/ .51
NL-A54	lb.	.295	/ .325
Eastman DI (2 ethyl hexyl) adipate	lb.	.40	/ .44
DI (2 ethyl hexyl) azelate	lb.	.455	/ .495
DI (2 ethyl hexyl) phthalate, diethyl phthalate, dimethyl phthalate, Plasticizer 84	lb.	.25	/ .29
DI (methoxy ethyl) phthalate	lb.	.425	/ .465
Dibutyl phthalate	lb.	.26	/ .30
Sebacate	lb.	.655	/ .685
Polymeric plasticizer NP-10	lb.	.50	/ .53
Triacetin	lb.	.365	/ .405
Tributyrin	lb.	.69	
Elastex 20 A, 60-A	lb.	.40	/ .44
50B, 10-P, 28-P, 40-P	lb.	.25	/ .29
18-P	lb.	.255	/ .295
48-P	lb.	.245	/ .285
82-P	lb.	.265	/ .305
90-P	lb.	.26	/ .30
36-R	lb.	.4325	/ .4675
37-R	lb.	.70	/ .715
Ethox	lb.	$0.50	/ $0.525
Flexol 3GH	lb.	.44	/ .46
3G0	lb.	.53	/ .55
4G0	lb.	.325	/ .35
8N8	lb.	.355	/ .38
10-10, 10-A	lb.	.29	/ .315
77-G, 426	lb.	.27	/ .295
380	lb.	.305	/ .33
810	lb.	.285	/ .31
A-26	lb.	.40	/ .425
B-400	lb.	.25	/ .275
CC-55	lb.	.305	/ .33
DOP	lb.	.28	/ .305
R2H	lb.	.59	
TOF	lb.	.43	/ .455
Flexricin 66	lb.	.3275	
P-4	lb.	.30	
P-6	lb.	.37	
P-8	lb.	.32	
Good-Rite GP-233, -235, -236	lb.	.40	/ .435
GP-261	lb.	.285	/ .32
GP-265	lb.	.29	/ .325
GP-266	lb.	.295	/ .33
Harchem butyl stearate	lb.	.2525	/ .3425
Caprylalcohol	lb.	.195	/ .30
Caprylene	lb.	.10	/ .205
Dibenzyl sebacate	lb.	.92	/ 1.01
Dibutyl phthalate	lb.	.30	/ .395
Dibutyl sebacate	lb.	.68	/ .77
Dicapryl phthalate	lb.	.27	/ .36
Dihexyl adipate	lb.	.40	/ .495
Dihexyl phthalate	lb.	.30	/ .395
Dihexyl sebacate	lb.	.65	/ .74
Diisodecyl phthalate	lb.	.29	/ .385
Diisooctyl adipate	lb.	.40	/ .495
Diisooctyl phthalate	lb.	.28	/ .375
Dimethyl sebacate	lb.	1.30	1.39
Dioctyl adipate	lb.	.40	/ .495
Dioctyl phthalate	lb.	.28	/ .375
Dioctyl sebacate	lb.	.60	/ .69
Harchemex	lb.	.24	/ .345
Harflex 300	lb.	.58	/ .675
325	lb.	.4325	/ .52
500	lb.	.315	/ .41
Isooctyldecyl phthalate	lb.	.285	/ .38
Methyl hexyl ketone	lb.	.26	/ .365
Sebacic acid, CP	lb.	.77	/ .80
Purified	lb.	.69	/ .81
Harahaw dibutyl phthalate	lb.	.325	/ .385
Kapsol	lb.	.33	/ .355
Kay-Fries diethyl phthalate	lb.	.275	/ .36
Dimethyl phthalate	lb.	.28	/ .365
Kessoflex BCL	lb.	.365	/ .375
BCO	lb.	.355	/ .365
BCP	lb.	.33	/ .36
BCS	lb.	.305	/ .315
BO	lb.	.26	/ .28
BS	lb.	.235	/ .26
DBT	lb.	.64	
DDA, DIOA, DOA	lb.	.40	/ .435
DOZ	lb.	.46	/ .50
MCO	lb.	.3225	/ .3525
MCP	lb.	.37	/ .40
MCS	lb.	.33	/ .34
ODA	lb.	.47	/ .50
TRA	lb.	.37	/ .40
KP-23	lb.	.315	/ .32
-90	lb.	.40	/ .435
-140	lb.	.46	/ .485
-201	lb.	.58	/ .59
-220, -260	lb.	.33	/ .365
-555	lb.	.595	/ .60
Kronisol	lb.	.33	/ .365
Kronitex AA, I, K-3, MX	lb.	.325	/ .36
Methox	lb.	.385	/ .41
Monoplex DBS	lb.	.64	/ .665
DCP	lb.	.2925	/ .32
DOS	lb.	.58	/ .605
S-38	lb.	.215	/ .24
S-70	lb.	.3925	/ .42
S-71	lb.	.45	/ .475
Monsanto dibutyl phthalate	lb.	.26	/ .30
Diethyl, dimethyl, DOP, DIOP	lb.	.25	/ .29
Diphenyl phthalate	lb.	.51	/ .535
DIDP	lb.	.26	/ .30
DOA, DIDA, DNODA	lb.	.40	/ .435
HB-20	lb.	.15	/ .17
HB-40	lb.	.19	/ .22
Tricresyl phosphate	lb.	.325	/ .36
Triphenyl phosphate	lb.	.415	/ .435
Morflex P 50	lb.	.68	/ .71
National Polychemicals: Dibutyl phthalate	lb.	.30	/ .335
Diisodecyl phthalate	lb.	.29	/ .33
Dioctyl phthalate	lb.	.28	/ .32
Tetraflex R-122	lb.	.27	/ .3050
Naugatuck decylbutyl phthalate	lb.	.27	/ .30
Dibutyl phthalate	lb.	.30	/ .33
Sebacate	lb.	.645	/ .67
Diisooctyl adipate, dioctyl adipate	lb.	.425	/ .455
Diisooctyl phthalate, dioctyl phthalate, isooctyl decyl phthalate	lb.	.305	/ .335
Dinonyl adipate	lb.	.445	/ .475
Dioctyl sebacate	lb.	.585	/ .61
Epoxy plasticizer	lb.	.335	/ .36
Tricresyl phosphate	lb.	.345	/ .375
Ohio-Apex butyl oleate	lb.	.255	/ .265
Stearate	lb.	.22	/ .255
Diallyl phthalate	lb.	.49	/ .525
Dibutyl phthalate	lb.	.30	/ .335
Di-Carbitol phthalate	lb.	.49	/ .495
Diisobutyl adipate	lb.	.41	/ .445
Diisodecyl phthalate	lb.	.29	/ .325
Dioctyl phthalate	lb.	.28	/ .315

D.I.O.P.	lb.	$0.28 /	$0.315
Tributyl phosphate	lb.	.50 /	.535
Ohopex Q-10	lb.	.28 /	.315
R-9	lb.	.3525/	.3775
Paraplex S-B	lb.	.29 /	.3478
AL-111	lb.	.32 /	.3275
G-20	lb.	.76 /	.7675
G-25	lb.	.76 /	.77
G-40	lb.	.4825/	.51
G-50	lb.	.39 /	.4175
G-53	lb.	.4325/	.46
G-60, -61	lb.	.3325/	.36
G-62	lb.	.3525/	.38
RG-2	lb.	.41 /	.6575
RG-7	lb.	.33 /	.6575
RG-8	lb.	.505 /	.335
RG-10	lb.	.52 /	.5125
Pfizer acetyl tributyl citrate, tech	lb.	.32	.5275
Acetyl triethyl citrate, tech	lb.	.36 /	.57
Triethyl citrate	lb.	.4575/	.58
Plasticizer 1	lb.	1.17 /	1.37
Plasticizer 120	lb.	.44 /	.49
Plastoflex #3	lb.	.52 /	.57
#520	lb.	.36 /	.435
DBE	lb.	.50 /	.55
MGB	lb.	.29 /	.37
VS	lb.	.3575/	.3975
Plastolein 9050 DHZ	lb.	.52 /	.57
9055 DGP	lb.	.32 /	.37
9057 DIOZ, 9058 DOZ	lb.	.405 /	.505
9078 LT	lb.	.40 /	.45
9250 THFO	lb.	.3575/	.4075
9404 TGP	lb.	.3725/	.4225
9715 and 9720 polymeric	lb.	.365 /	.415
Polycizer 162	lb.	.25 /	.285
562	lb.	.255 /	.29
662, 662 BPA	lb.	.26 /	.295
Polycon #7, 9, 10, 11	lb.	.305 /	.335
#30	lb.	.30 /	.33
#31	lb.	.27 /	.30
#40	lb.	.245 /	.275
PX-104	lb.	.30 /	.33
-108, -118, -120, -138	lb.	.305 /	.335
-114	lb.	.27 /	.30
-208, -220, -238	lb.	.425 /	.455
-404	lb.	.645 /	.67
-438	lb.	.585 /	.61
-800	lb.	.325 /	.35
-917	lb.	.33 /	.36
Pycal 40	lb.	.3875/	.4375
60	lb.	.60 /	.6352
63	lb.	.80 /	.835
94	lb.	.3275/	.3775
140	lb.	.35 /	.40
170	lb.	.275 /	.325
194	lb.	.2775/	.3275
RC Plasticizers:			
B-17	lb.	.21 /	.245
BD-8	lb.	.38 /	.4125
BIDP	lb.	.27 /	.305
DIDA, DIOA, DOA, ODA	lb.	.40 /	.435
DIDP	lb.	.29 /	.325
DIOP, DOP	lb.	.28 /	.315
DIOS, DOS	lb.	.60 /	.63
O-16	lb.	.275 /	.3075
ODP	lb.	.285 /	.32
TG-8	lb.	.3125/	.3425
TG-9	lb.	.41 /	.4425
Santicizer 1-H	lb.	.50 /	.51
3	lb.	.46 /	.47
8	lb.	.43 /	.44
9	lb.	.39 /	.42
140	lb.	.325 /	.36
141	lb.	.34 /	.37
160	lb.	.25 /	.28
213	lb.	.27	
214	lb.	.29	
601	lb.	.32	
602	lb.	.305	
B-16	lb.	.4875/	.4975
E-15	lb.	.5075/	.5375
M-17	lb.	.4275/	.4575
Staflex AX	lb.	.43	
BR	lb.	.26 /	.29
CP	lb.	.28 /	.31
DBES, DOS	lb.	.61 /	.635
DIOA, ODA	lb.	.435 /	.465
DIOP, DOP, MP	lb.	.305 /	.335
DOZ	lb.	.48 /	.5075
IXA	lb.	.32 /	.35
KA	lb.	.36 /	.3875
KD	lb.	.44 /	.4675
Witcizer #100	lb.	.26 /	.27
#101	lb.	.31 /	.32
#200	lb.	.195 /	.205
#201	lb.	.235 /	.245
#300	lb.	.30 /	.33
#312, 313	lb.	.305 /	.33
#412	lb.	.435 /	.465

Resins & Molding Compounds

Acrylic

Cadco cast rods	lb.	1.63 /	6.47
polished	lb.	1.89 /	7.22
tubes	lb.	1.39 /	5.12
Lucite injection molding powders:			
Colorless, transparent	lb.	.55	
Std. colors	lb.	.59 /	1.00
Stock colors	lb.	.59 /	.84
Granular Powders for compression & extrusion	lb.	.51 /	.75
Plexiglas molding powders:			
Colorless	lb.	$0.55 /	$0.80
Colors, stock	lb.	.59 /	.84
Custom	lb.	.59 /	1.00
Sheets, Types I-A & II			
Colorless	sq. ft.	.80 /	22.18
Colors	sq. ft.	.88 /	1.10
Type R, Colorless	sq. ft.	.60 /	12.64
Colors	sq. ft.	.69 /	1.07
Type RL, colorless	sq. ft.	1.27 /	1.50
Colors	sq. ft.	1.52 /	1.80
Polycast 1	sq. ft.	.80 /	2.40

Alkyd

Plaskon foundry resin 580-11L	lb.	.245 /	.275
Molding Compound, Type 411	lb.	.43 /	.60
Type 413, 417	lb.	.57 /	.74
Type 420 black	lb.	.44 /	.695
Type 422 colored	lb.	.51 /	.695
Mottle	lb.	.52 /	.705
Natural	lb.	.49 /	.60
Type 430	lb.	.34 /	.50

Cellulosic

Cellulose acetate:			
Celanese cast & extruded film:			
Standard length rolls, clear	lb.	.67 /	1.03
Colors	lb.	.93 /	1.19
Matte finish	lb.	1.48 /	1.82
Stock & cut sheets, clear	M. sq. in.	.033 /	.11
Colors	M. sq. in.	.044 /	.136
Matte finish	M. sq. in.	.089 /	.165
Celanese cast sheeting:			
Standard length rolls, clear	M. sq. in.	.129 /	1.47
Matte finish	M. sq. in.	.16 /	.657
Tinted	M. sq. in.	.243 /	.722
Stock & cut sheets, clear	M. sq. in.	.145 /	1.55
Matte finish	M. sq. in.	.183 /	.767
Tinted	M. sq. in.	.259 /	.862
Lumarith molding compounds:			
Group I	lb.	.52 /	.61
Group II	lb.	.48 /	.57
Group III	lb.	.41 /	.50
Non-stock extruded rolls, clear	M. sq. in.	.14 /	1.34
Colors	M. sq. in.	.18 /	1.65
Extruded sheets, clear	M. sq. in.	.17 /	2.34
Colors	M. sq. in.	.19 /	2.15
Stock extruded rolls, clear	M. sq. in.	.14 /	.97
Colors	M. sq. in.	.18 /	1.00
Extruded sheets, clear	M. sq. in.	.17 /	1.84
Colors	M. sq. in.	.19 /	1.84
Poly-Cell Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III	lb.	.38 /	.48
Group IV	lb.	.57 /	.66
Group V	lb.	.52 /	.61
Tenite Acetate, Group 1	lb.	.50 /	.59
Group 2	lb.	.46 /	.55
Group 3	lb.	.41 /	.51
Group 4	lb.	.38 /	.49
Group 5	lb.	.65 /	.75
Cellulose acetate butyrate:			
Tenite butyrate	lb.	.62 /	.71
A pearls	lb.	.72 /	.81
Blacks, reprocessed	lb.	.50 /	.58
Cellulose propionate:			
Forticel	lb.	.63 /	.71
Essence pearls	lb.	.73 /	.81
Reprocessed blacks	lb.	.41 /	.48
Ethyl cellulose:			
Dyeform 720, 721	lb.	1.29 /	1.52
Ethocel PG	lb.	.72 /	.80
Bulk, reg.	lb.	.66 /	.81
Std., 7 cps.	lb.	.71 /	.86
Hercocel E	lb.	.72 /	.88

Epoxy

Araldite 502, 506, 6005, 6010	lb.	.77 /	.86
6020, 6030, 6040	lb.	.80 /	.86
6060	lb.	.75 /	.83
6071, 6075	lb.	.615 /	.6225
6084	lb.	.595 /	.6025
6097	lb.	.6025/	.6125
6099	lb.	.69 /	.6975
Bakelite ERL Series	lb.	.80 /	.995
Emerson & Cuming:			
Eccobild 121	lb.	1.20 /	1.60
127	lb.	3.50 /	3.75
420	lb.	.84 /	.99
430	lb.	.90 /	1.15
470	lb.	2.65 /	3.25
490	lb.	1.50 /	1.70
Epi-Rez 504	lb.	$0.65 /	$0.715
507, 510	lb.	.62 /	.685
515	lb.	.75 /	.785
520	lb.	.575 /	.5852
522	lb.	.555 /	.5628
Epocast 2, 3, 5	lb.	1.33 /	1.77
4-B-2, 4-B, 4-C, 4-C-T, 4-D, Paste	lb.	1.09 /	1.15
Epon 562	lb.	1.09 /	1.12
815, 820	lb.	.65 /	.71
828	lb.	.62 /	.685
834	lb.	.75 /	.785
834-X-90	lb.	.685 /	.715
864	lb.	.885 /	.92
864-C-75	lb.	.6525/	.6625
1001	lb.	.575 /	.5825
1001-A-80	lb.	.515 /	.525
1001-BT-70	lb.	.4375/	.4675
1001-CX-75	lb.	.465 /	.495
1001-T-75	lb.	.47 /	.48
1002, 1007	lb.	.555 /	.5625
1004	lb.	.50 /	.535
1007-CT-55	lb.	.395 /	.405
1009	lb.	.63 /	.6375
Furane CN-502	lb.	1.33 /	1.77
Jet-Kote (with cat.)	gal.	7.50 /	10.00
Maraset 602, 610, 610V, 612B, 613, 648	lb.	1.20 /	1.70
604A, 607	lb.	1.17 /	1.40
608	lb.	1.17 /	1.65
614A, 631A, 618A, 640	lb.	1.32 /	1.77
645	lb.	1.15 /	1.70
Reichhold Polytool Resins: 6125, 6130, 6140	lb.	.80 /	1.58
Rezolin L-900, 900W	lb.	1.00 /	1.94
902	lb.	2.41	
906	lb.	1.19 /	1.80
910	lb.	1.086 /	2.34
916, 916A	lb.	1.19 /	1.71
940	lb.	1.285 /	2.29
930A	lb.	1.29 /	1.90
933A	lb.	1.29 /	1.80
953A	lb.	1.665 /	1.99
LT-904	lb.	.996 /	1.83
914	lb.	1.073 /	2.18
932	lb.	1.05 /	1.79
Sealcast 501	lb.	1.55 /	1.65
502, 504, 505	lb.	1.75 /	1.85
503	lb.	1.65 /	1.75
Sealfoam 601	lb.	2.90 /	3.15
602	lb.	3.00 /	3.25
603	lb.	2.50 /	2.75
604	lb.	2.85 /	3.10
Toolplastik packages: L-900, L-930	lb.	1.59 /	2.29
L-902	lb.	1.69 /	1.84
L-904	lb.	1.54 /	2.19
L-910	lb.	1.94 /	2.34
L-914	lb.	1.83 /	2.19
L-931	lb.	1.75 /	1.99
L-940	lb.	2.05 /	2.29

Fluorocarbon

Bakelite FGBB-33789, FGEB-34790, FXMA-50590, FXMB-50344	lb.	9.00 /	10.00
FGEB-32788, FXMB-50090	lb.	12.00 /	14.00
FVTD	lb.	11.00 /	13.00
FVTH, FVTS	lb.	8.50 /	9.50
Kel-F Grade 270, 300 High density	lb.	6.50 /	9.00
Low density	lb.	6.00 /	8.50
Grade 300—P-25 High density	lb.	7.50 /	10.00
Low density	lb.	7.00 /	9.50
Grade 500 F, 500-R High density	lb.	7.00 /	9.50
Low density	lb.	6.50 /	9.00
Polyfluoron, high density pellets, grades HT, MT, LT	lb.	6.50 /	9.00
colored	lb.	7.00 /	9.50
Low density pellets, Clear grades HT, MT, LT	lb.	6.00 /	8.50
colored	lb.	6.50 /	9.00
Liquid dispersions, 40% HT, MT, LT	lb.	4.20 /	4.40
35% HT, MT, LT	lb.	3.20 /	3.85
30% HT, MT, LT	lb.	3.15 /	3.30
25% HT, MT, LT	lb.	2.65 /	2.75
Mikron-atomized powder, clear dispersion grades HT, MT, LT	lb.	8.00 /	10.50
colored	lb.	8.50 /	11.00
Teflon 1	lb.	4.10 /	4.50
5	lb.	4.35 /	4.75
6	lb.	6.65 /	7.05
7	lb.	4.60 /	5.00
30 aqueous dispersion	lb.	5.15 /	5.65

Melamines

Fiberite 2015 (black & pastels)	lb.	.57 /	.62
Pelleted	lb.	.61 /	.66
Cymel 402	lb.	.51 /	.53
404R, 404T	lb.	.85 /	.95
405, 428, 430	lb.	.38 /	.40
480	lb.	.265 /	.315

1077, 1079	lb.	$0.47	$0.77
Ungranulated	lb.	.45	.75
1500	lb.	.42	.55
1502	lb.	.50	.63
3020	lb.	.57	.72
3135	lb.	.85	1.05
3136	lb.	1.05	1.15
P-592	lb.	.65	.75
Plaskon	lb.	.44	.75

Phenolic

91-LD	lb.	1.50	2.50
Admirex PL-50	lb.	.215	
UP-11	lb.	.2325	
Bakelite general purpose	lb.	.187	.3525
BMG-5000	lb.	.19	.30
Colors	lb.	.2375	.435
Chem. resist	lb.	.23	.40
Electric Insul.	lb.	.2725	.4125
Heat resist.	lb.	.19	.35
Impact resist.	lb.	.24	.40
Barrett foundry resins, liquid	lb.	.2125	.2425
Powdered	lb.	.27	.355
Insulation resins	lb.	.15	.175
Molding resin 313, 314, 317	lb.	.27	.285
316	lb.	.295	.31
1502, -3, -4, -5, R-110R	lb.	.25	.265
R-114	lb.	.285	.30
Corfoam 107, 114	lb.	.55	.82
Cyacor 151	lb.	.215	.235
191	lb.	.13	.16
Durez, Brake lining resins:			
8054, powdered	lb.	.35	.39
13848, powdered	lb.	.29	.33
14000, powdered	lb.	.32	.36
Foundry resins:			
18115, liquid	lb.	.22	.23
18123, 18250, powdered	lb.	.265	.275
Resins, rubber compounding:			
12603, lump	lb.	.245	.255
12687, powdered	lb.	.36	.40
13355, powdered	lb.	.275	.315
Resins, wood flour bonding:			
12763, 18520, powdered	lb.	.30	.31
Durite GP	lb.	.195	.24
HR	lb.	.191	.3025
IM	lb.	.24	.415
SG	lb.	.195	.3575
Dyform	lb.	1.10	1.35
Fiberite 1078	lb.	.43	.47
1153	lb.	.47	.50
1164	lb.	.475	.51
1270, 1330, 1332	lb.	.395	.43
1271, 1347, 1389	lb.	.40	.44
1346	lb.	.42	.4925
2015	lb.	.57	.63
4030	lb.	.95	.99
4041	lb.	.635	.65
4035	lb.	.60	.82
6100	lb.	1.10	1.12
FM-926	lb.	.44	.455
-927	lb.	.42	.435
-1132, -3510, -3515	lb.	.40	.43
-1914, -1996	lb.	.39	.405
-10365, -11678	lb.	.68	.715
-11547, -17610	lb.	1.08	1.10
-14111	lb.	.43	.445
-17067	lb.	.85	.865
X409	lb.	.285	.325
G-E molding powders:			
12401	lb.	.31	.41
13408, 12486	lb.	.205	.215
12410, 12420	lb.	1.50	1.60
12432	lb.	.405	.505
12433	lb.	.565	.665
12435	lb.	.25	.35
12439-A, 12466	lb.	.265	.365
12444	lb.	.435	.535
12463	lb.	.415	.515
12467	lb.	.51	.61
12487, 12489, 12884, 12887	lb.	.365	.465
12491, 12493, 12853, 12900, 12901, 12902, 12920, 12921	lb.	.21	.31
12494	lb.	.385	.485
12808	lb.	.50	.60
12809	lb.	.66	.76
12871-A	lb.	.22	.32
12824	lb.	.505	.605
12841, 12906	lb.	.255	.355
Loven LHR-401, -403	lb.	.225	.23
-407, -409	lb.	.60	1.00
-408	lb.	.25	.255
LI-201	lb.	.39	.40
-207	lb.	.475	.48
-209	lb.	.60	1.00
-212	lb.	.425	.43
LM-110, -119	lb.	.19	.195
-101	lb.	.24	.245
-116	lb.	.255	.26
-117	lb.	.225	.23
-118	lb.	.1975	.2025
LMI-301	lb.	.2525	.2575
-303	lb.	.345	.35
-304	lb.	.60	1.00
-307	lb.	.3075	.3125
LMM-801, -803	lb.	.2125	.2175
-804, -811	lb.	.245	.25
-807	lb.	.215	.22
Marblette 76, 77	lb.	.50	.60
Foam resin 1076	lb.	.50	.60
Plenco foundry resins	lb.	$.27	$0.35
Molding empds. gen. purpose	lb.	.185	.235
Heat resist.	lb.	.19	.24
Improved impact	lb.	.225	.28
Min. bleed	lb.	.185	.195
Radio & TV	lb.	.20	.215
Stock	lb.	.205	.34
Reichhold Foundry Resins:			
Corciment	lb.	.135	.17
Corovit	lb.	.275	.31
Foundrez, core binder liquids	lb.	.21	.25
Shell molding liquids	lb.	.195	.245
Powders	lb.	.2675	.3025
Plyophen molding cmpds.:			
5440, 5596, 5655, 5660	lb.	.30	.325
5510, 5510-C	lb.	.34	.365
5657, 5658, 5661	lb.	.315	.34
Reilly general purpose	lb.	.195	.20
Heat & impact resist.	lb.	.20	.205
Resinox molding compounds:			
Gen. purpose & heat resist.	lb.	.205	.215
Impact	lb.	.255	.3225
Low elec. loss	lb.	.31	.365
Special grade	lb.	.215	.255
Rogers phenolic molding compounds:			
RX 425	lb.	.29	.295
Special colors	lb.	.34	.405
RX 428	lb.	.355	.36
Special colors	lb.	.42	.465
RX 429	lb.	.365	.37
Special colors	lb.	.395	.48
RX 431	lb.	.4125	.4175
Special colors	lb.	.455	.55
RX 438	lb.	.4675	.4725
RX 441, 455	lb.	.32	.325
RX 442	lb.	.3475	.3525
RX 447	lb.	.5025	.51
RX 448	lb.	.355	.36
RX 458	lb.	.38	.385
RX 469	lb.	.365	.37
RX 470, 480	lb.	.40	.405
RX 478, 488	lb.	.415	.43
RX 525, 545	lb.	.29	.295
RX 530	lb.	.4125	.417
Special colors	lb.	.42	.475
RX 547	lb.	.37	.375
RX 625	lb.	.395	.40
RX 628	lb.	.455	.46
Schenectady shell mold resins	lb.	.26	.28
Synvar molding compounds, PM series	lb.	.195	.205
Synvaren industrial resins, liquid, 640	lb.	.30	.335
675	lb.	.305	.575
920	lb.	.21	.245
935	lb.	.195	.23
9203	lb.	.173	.208
PBL-2	lb.	.33	.365
Synvarite powder resins, GW 2400	lb.	.375	.395
PBL 100	lb.	.31	.33
108 FF	lb.	.38	.40
210, 3301	lb.	.36	.38
PNL 12 HL 90	lb.	.3025	.3225
355 PD	lb.	.315	.335
1270 HL	lb.	.2875	.3075
Toolplastik No. 8000	lb.	.48	.72

Polyamide

Catalin Nylons:			
Natural	lb.	1.18	1.45
Black and white	lb.	1.28	1.45
Colors, std.	lb.	1.37	1.65
Special	lb.	1.37	1.80
Fiberfil Nylon G, natural	lb.	1.70	1.90
Standard colors	lb.	1.80	2.20
Nylatron G5	lb.	1.28	
Plaskon 8200, 8201 natural	lb.	1.33	1.50
Black	lb.	1.53	1.70
White	lb.	1.43	1.60
Other colors	lb.	1.63	1.80
Spencer Nylon 401, 402	lb.	1.18	1.66
600, 603	lb.	1.18	1.65
601	lb.	1.28	1.45
602	lb.	1.33	1.80
604, 606	lb.	1.28	1.75
Versamid 115	lb.	.64	.82
Zytel molding powder	lb.	1.435	1.60
Zytel, natural color	lb.	1.18	1.35
Blacks and whites	lb.	1.43	1.80
Colors	lb.	1.63	2.05

Polyesters

Acme 1-501	lb.	.82	.93
1-501A	lb.	.87	.98
1-503	lb.	2.75	3.50
1-510	lb.	.89	1.00
Atlac 363E-02Z, -12Z	lb.	.66	.69
-32Z	lb.	.68	.71
382E	lb.	.57	.60
FP	lb.	.66	.69
Bakelite Polyester resins	lb.	.35	.75
Diall 50-01	lb.	2.45	
50-51	lb.	3.25	3.50
50-52	lb.	3.50	
51-01	lb.	.87	1.15
52-01	lb.	2.25	2.50
52-20-30	lb.	1.50	
Diall 50-01, 50-51, 50-52	lb.	2.75	3.50
51-01	lb.	.87	.98
52-01	lb.	1.95	2.50
52-20-30	lb.	1.30	1.50
Fibercore 1000, 2000	lb.	$0.50	$0.65
3000	lb.	.55	.70
G-E polyesters			
AR 401	lb.	.35	.365
AR 403, 480	lb.	.34	.355
AR 403 LS, 480 LS	lb.	.355	.37
AR 493	lb.	.40	.415
AR 499	lb.	.435	.45
AR 501	lb.	.455	.47
Hetron 33	lb.	.39	.405
32A	lb.	.435	.45
92	lb.	.43	.445
93LS	lb.	.485	.50
IC-312, -400, -514, -548, -625, -730, -800	lb.	.35	.385
-312-2	lb.	.365	.38
-336, -382, -706	lb.	.37	.385
-401	lb.	.44	.455
-420	lb.	.355	.37
-433	lb.	.38	.395
-636, -670	lb.	.48	.495
-638, -689	lb.	.55	.565
-670-2	lb.	.50	.515
-671	lb.	.405	.42
Filled resins	lb.	.255	.54
Laminac 4101, 4105, 4106, 4110, 4116	lb.	.34	.355
4102, 4120	lb.	.39	.405
4103, 4123, 4128	lb.	.35	.365
4107, 4109	lb.	.51	.525
4111, 4129	lb.	.46	.475
4119	lb.	.41	.425
4192	lb.	.365	.38
4202	lb.	.56	.575
Marco resins:			
CEL-101, Marcothix 1, 3	lb.	.51	.525
Marcothix, 5, 7, 8	lb.	.47	.485
Marcothix 9, MR-31C, 28H, 41-R	lb.	.37	.385
Marcothix 10, MR-28C, -28V, -31V, -37C, -37CX	lb.	.34	.355
MR-28CS	lb.	.36	.375
MR-28R, -42R	lb.	.35	.365
MR-28RL, -37RL	lb.	.365	.38
MR-30C	lb.	.45	.465
MR 33C	lb.	.54	.555
MR 40R	lb.	.39	.405
MR-60C	lb.	.42	.435
MR-61H	lb.	.43	.445
Mylar, rolls, types A & C	lb.	2.50	4.80
Type D	lb.	3.00	3.30
Sheets, type A	M. sq. in.	.09	1.11
Type C	M. sq. in.	.09	.15
Type D	M. sq. in.	.53	1.34
Plaskon 911, 920	lb.	.55	.665
941, 942, 951, 9411	lb.	.35	.465
943	lb.	.41	.525
9404	lb.	.365	.48
9406	lb.	.355	.465
9500, 9510, 9511	lb.	.35	.465
9600	lb.	.44	.555
Pleogen 1100, 1102, 1300, 1810-3, 1812-2, 1816-3, 1825, 1827, 1828, 1829, 1833, 1834, 1870-2, 1872-2	lb.	.34	.355
1150, 1153, 1501, 1602	lb.	.35	.365
1201	lb.	.50	.51
1405	lb.	.38	.395
1800, 1802	lb.	.45	.46
1813	lb.	.36	.37
1822	lb.	.39	.40
1877, 2432	lb.	.42	.435
Polycast 2	sq. ft.	1.89	5.18
3	sq. ft.	1.08	18.00
6	sq. ft.	.66	3.10
7	sq. ft.	.72	7.18
CR-39	sq. ft.	1.25	20.00
Polylite 8000, 8001, 8005, 8007, 8017, 8037, 8173, 8200	lb.	.34	.355
8006, 8008, 8009, 8039, 8166	lb.	.35	.365
8016, 8100	lb.	.365	.38
8050	lb.	.41	.425
8061, 8065	lb.	.44	.455
8120	lb.	.48	.495
8150	lb.	.45	.465
8170, 8237	lb.	.38	.395
8180, 8181	lb.	.36	.375
8400	lb.	.56	.575
Pre-Imp.	lb.	.68	.85
Thermaflow 100, 200, 300	lb.	.48	.82
400, 500	lb.	.52	.87
1,000, 2,300	lb.	.34	.55
2,400	lb.	.36	.58
Vibrin 114, 117, 152, 154	lb.	.34	
115A	lb.	.38	
121	lb.	.46	
135	lb.	3.00	
142	lb.	.50	
151	lb.	.35	
152LS-4	lb.	.355	
153	lb.	.40	
X-1633-A	lb.	.49	
X-1636-W	lb.	.585	

Polyethylene

A-C No. 6, 617	lb.	.30	.37
No. 6A, 7, 617A	lb.	.35	.42
No. 615, G-201	lb.	.38	.45
No. 629	lb.	.40	.47
No. 729	lb.	.45	.52
Alathons, Group I	lb.	.35	.43
Group II	lb.	.37	.515
Group III	lb.	.375	.42

Bakelite DE Series	lb.	$0.43	/ $0.725
DYGT	lb.	.54	/ .69
DVLT, DVNF, DYNH	lb.	.41	/ .59
DYNJ	lb.	.44	/ .62
DYNK	lb.	.45	/ .63
Catalin high density, nat.	lb.	.38	/ .42
Black	lb.	.40	/ .445
Colors	lb.	.44	/ 1.01
Fortiflex A-20, 70, 250, 500, nat.	lb.	.43	/ .49
colors	lb.	.49	/ 1.06
black	lb.	.455	/ .495
Grex, nat.	lb.	.38	/ .42
General purpose black	lb.	.405	/ .445
Colors and special purpose black	lb.	.44	/ 1.01
Hi-fax, nat.	lb.	.38	/ .42
Colors	lb.	.44	/ 1.01
Electrical grade, nat.	lb.	.38	/ .42
Colors	lb.	.46	/ 1.03
Monofilament, nat.	lb.	.38	/ .42
Colors	lb.	.44	/ 1.01
Marlex, types 2, 9, 15, 35, 50-			
Black, general purpose	lb.	.405	/ .445
High dispersion and plain	lb.	.44	/ 1.01
Natural	lb.	.38	/ .42
Petrothene 100, 101, 200, 202, 203, 205, 206, 207, 208, 301	lb.	.35	/ .45
300, 300-200	lb.	.465	/ .565
300-6	lb.	.425	/ .525
301, electrical grade	lb.	.41	/ .51
301-6	lb.	.37	/ .47
301-200, 301-202, 302-506, 560	lb.	.375	/ .48
302-6	lb.	.39	/ .49
Poly-Eth 1005, 1007, 1407, 1408.5, 1709, 2007, 2205, 2206, 2215, 2226, 2235, 2476, 2477, 2486	lb.	.35	/ .49
1008.5, 1407	lb.	.33	/ .47
3215	lb.	.37	/ .51
3226	lb.	.375	/ .515
3405	lb.	.38	/ .52
3495	lb.	.50	/ .64
Hi-D 1504, 2504, 3504	lb.	.42	/ .56
Reynolon 1000, P series	lb.	.60	/ .80
Rulan 2	lb.	.48	/ .52
Super Dylan, black	lb.	.405	/ .47
colors and nat.	lb.	.38	/ .42
Tenite Group 1	lb.	.41	/ .45
Group 2	lb.	.43	/ .47
Group 3	lb.	.46	/ .50
Group 4	lb.	.39	/ .43
Group 5, 6	lb.	.50	/ .72
Group 7	lb.	.60	/ .82
Group 8	lb.	.70	/ .92

Polypropylene

Moplen, natural	lb.	.49	/ .55
Standard colors	lb.	.58	/ .85
Pro-Fax, natural	lb.	.49	/ .72
Standard colors	lb.	.58	/ 1.18

Silicone

Bakelite GMGA-5001, -5002	lb.	2.75	/ 3.10
5003	lb.	4.00	/ 4.35
5004	lb.	5.40	/ 5.75
Dow Corning 301	lb.	3.60	/ 4.00
2103	lb.	1.55	/ 1.65
2105, 2106	lb.	1.59	/ 1.70

Styrenes

Amparet, crystal	lb.	.315	/ .335
Colors, std.	lb.	.345	/ .365
Special	lb.	.345	/ .75
Pearl	lb.	.41	/ .75
Phosphorescent	lb.	.695	/ 1.00
Tinsel	lb.	.41	/ .67
Confetti	lb.	.51	/ .70
Bakelite BMC series, nat.	lb.	.45	/ .685
Colors	lb.	.50	/ .735
BMS, SMD series, crystal	lb.	.295	/ .31
Colors, std.	lb.	.335	/ .35
Special	lb.	.335	/ .52
RMD series, nat.	lb.	.45	/ .685
Colors	lb.	.50	/ .735
TGD series	lb.	.33	/ .35
Colors, std.	lb.	.36	/ .38
Special	lb.	.36	/ 1.00
TMD series	lb.	.33	/ .40
Colors, std.	lb.	.36	/ .43
Special	lb.	.36	/ 1.00
Catalin, extra high impact, Natural & black	lb.	.385	/ .415
Colors, std.	lb.	.425	/ .445
Special	lb.	.425	/ 1.00
High impact, natural & black	lb.	.32	/ .34
Colors, std.	lb.	.345	/ .385
Special	lb.	.345	/ 1.00
General purpose, crystal	lb.	.2425/	.2575
Colors, std.	lb.	.2725/	.2925
Special	lb.	.2725/	1.00
Medium impact, colors, std.	l.	.34	/ .365
Special	lb.	.34	/ 1.00
Utility black, gen. purpose	lb.	.1975	
Medium impact	lb.	.215	
High impact	lb.	.26	
Cycolac compounds:			
Natural powders	lb.	$0.53	/ $0.65
Natural & std. color pellets	lb.	.58	/ .62
Cymac 201	lb.	.405	/ .435
400	lb.	.2425/	.2575
Darex Copolymer 3	lb.	.47	/ .67
44G	lb.	.39	/ .58
X34	lb.	.42	/ .61
Lattices 3L	lb.	.415	/ .56
610L	lb.	.30	/ .46
3020	lb.	.32	/ .47
Dow Latex: styrene/ butadiene	lb.	.295	/ .57
Resins PS-2 & 3	lb.	.25	/ .35
butadiene	lb.	.30	/ .46
Dylite, expandable beads	lb.	.50	/ .60
Fiberfil Styrene G, natural	lb.	.55	/ 1.00
Standard colors	lb.	.65	/ 2.00
Koppers, Fibertuff	lb.	.55	/ 1.505
MC-185 series	lb.	.33	/ .355
-300 series	lb.	.33	/ 1.005
-400 series	lb.	.355	/ 1.005
Regular, crystal	lb.	.295	/ .315
Colors, std.	lb.	.335	/ .355
Special	lb.	.335	/ 1.005
Pearl	lb.	.41	/ 1.005
Phosphorescent	lb.	.695	/ 2.005
Kralastic, std. colors	lb.	.50	/ 1.10
Lustrex Hi-Flows 55, 66, 77, and Hi-Heat 99 crystals	lb.	.26	/ .275
LHA standard colors	lb.	.34	/ .365
special colors	lb.	.34	/ 1.00
Hi-Test 88 & 89 Natural & 844 black	lb.	.32	/ .34
standard colors	lb.	.345	/ .385
special colors	lb.	.345	/ 1.00
Marbon resins	lb.	.39	/ .46
Plio-Tuf C75, R100	lb.	.37	/ .45
G85	lb.	.52	/ .59
P100, std. colors	lb.	.41	/ .45
Polycast 4	sq. ft.	2.56	/ 11.07
Styron 475, natural	lb.	.33	/ .35
Colors, std.	lb.	.36	/ .38
Special	lb.	.36	/ 1.00
Sheets, std.	lb.	.55	/ .60
Special	lb.	.55	/ .62
480, natural black	lb.	.38	/ .40
Colors, std.	lb.	.41	/ .43
Special	lb.	.41	/ 1.00
647, crystal	lb.	.305	/ .32
Colors, special	lb.	.345	/ 1.34
66, 688, crystal	lb.	.295	/ .31
Colors, std.	lb.	.335	/ .35
Special	lb.	.335	/ 1.00
700, crystal	lb.	.295	/ .31
Colors, std.	lb.	.335	/ .35
Special	lb.	.335	/ 1.00
777 colors, std.	lb.	.355	/ .375
Special	lb.	.355	/ 1.00

Urea

Admirex Foundry Resins, SP-30	lb.	.27	
UP 50	lb.	.105	
Beetle C-498 Brown	lb.	.50	
No fines granulation	lb.	.22	/ .32
T-298 Black	lb.	.20	/ .30
MUP series, powder	lb.	.31	/ .50
Special colors	lb.	.31	/ .60
Granules	lb.	.34	/ .53
Special colors	lb.	.34	/ .63
Foundrez core binder	lb.	.105	/ .14
Plaskon molding cmpds: Black & Brown	lb.	.1875/	.30
Other colors	lb.	.30	/ .62
Foundry resins, liquid	lb.	.10	/ .13
Powdered	lb.	.2325/	.2525
Sylplast molding cmpds., granules	lb.	.33	
Powder	lb.	.30	
Sylplast molding compounds: Granules, std. colors	lb.	.34	
Special colors, gran.	lb.	.34	/ .46
Std. colors, powder	lb.	.29	/ .40
Special colors	lb.	.31	/ .43

Vinyls

Bakelite QG-5909	lb.	.35	/ .585
QG-5921	lb.	.41	/ .645
5924	lb.	.43	/ .665
QYNA, QYSM, QYSQ	lb.	.27	/ .47
QYNV	lb.	.30	/ .50
QYSJ	lb.	.28	/ .48
VG-1914, 1918	lb.	.37	/ .056
1985	lb.	.35	/ .585
5507	lb.	.31	/ .545
5544	lb.	.405	/ .64
5911	lb.	.315	/ .55
5980	lb.	.32	/ .555
7734	lb.	.28	/ .515
9031	lb.	.265	/ .50
9540	lb.	.275	/ .51
9960, 9970, 9980	lb.	.335	/ .57
VAGH	lb.	.55	/ .75
VMCH	lb.	.41	/ .61
VYDR, VYNW	lb.	.27	/ .47
VYHH	lb.	.32	/ .52
VYLF	lb.	.36	/ .56
VYNS	lb.	.44	/ .64
VYNV	lb.	.32	/ .52
Blacar No. BW-60	lb.	$0.315	/ $0.385
NEMA colors	lb.	.355	/ .425
No. BW-80	lb.	.405	/ .455
NEMA colors	lb.	.445	/ .495
No. PC white, ivory, black	lb.	.285	/ .335
Other colors	lb.	.325	/ .375
Celanese Chemulsions 100, 101, 102	lb.	.18	/ .275
201, 202	lb.	.20	/ .295
Darex Everplex A (wet wt.)	lb.	.21	/ .39
B (wet wt.)	lb.	.22	/ .40
G (wet wt.)	lb.	.21	/ .39
Copolymer Y (wet wt.)	lb.	.245	/ .28
PVA Emulsions (wet wt.)	lb.	.19	/ .355
Diamond PVC-45, 50	lb.	.27	/ .33
Dow PVC-100, 111	lb.	.38	/ .57
Du Pont Elvanol 50-42	lb.	.83	
51-05, 71-30	lb.	.64	
52-22	lb.	.75	
72-60	lb.	.57	
Escambia Pearls, 2185, 2200, 2225, 2250	lb.	.27	/ .47
Exon 402 A, 500, 666, 905, 911, 914, 921, 924, 931, 965	lb.	.25	/ .43
425, 450	lb.	.32	/ .50
461	lb.	9.75	
468	lb.	.30	/ .48
470	lb.	.48	/ .66
471	lb.	.45	/ .63
487	lb.	.275	/ .455
650, 654	lb.	.28	/ .46
Formvar	lb.	.865	/ 1.03
Gelva emulsions	lb.	.19	/ .205
Granules	lb.	.4175/	.617
Geon 101, 101 EP, 103 EP, 118, 202	lb.	.235	/ .415
121, 126	lb.	.265	/ .445
202, 427	lb.	.32	/ .50
404 HI	lb.	.35	/ .53
421	lb.	.44	/ .62
428	lb.	.28	/ .46
435	lb.	.245	/ .425
400 X 110	lb.	.41	/ .59
400 X 17	lb.	.37	/ .55
Krene, film	lb.	.505	/ .655
Sheeting	lb.	.49	/ .645
Marvinol: NF-1005	lb.	.34	/ .625
NF 1055, 3520	lb.	.275	/ .565
NF-3020	lb.	.41	/ .645
NF-3025	lb.	.38	/ .6025
NF-3040	lb.	.3375/	.625
NF-3045, 3050	lb.	.37	/ .60
NF 3055	lb.	.285	/ .575
NF 3060	lb.	.29	/ .575
NF 3065	lb.	.30	/ .58
NF-3070, 3075, 3080	lb.	.265	/ .505
NF-3085, 3090, 3095	lb.	.29	/ .525
NF 3505, 3515	lb.	.36	/ .595
NF 4510	lb.	.34	/ .575
NF 4005	lb.	.44	/ .675
NF-4010, 4015, 4020	lb.	.42	/ .705
NF 5015, 5020	lb.	.40	/ .655
NF 5025	lb.	.33	/ .585
NF 5030	lb.	.29	/ .545
NR 6015	lb.	.39	/ .685
NR 6020	lb.	.39	/ .675
NR 7002, 7045, 7060	lb.	.50	/ .73
VR 10	lb.	.28	/ .47
VR 12, -20, -21, -22, -24, -30	lb.	.27	/ .46
VR 50	lb.	.30	/ .49
Opalon 410	lb.	.30	/ .50
505, 510	lb.	.32	/ .52
1006	lb.	.315	/ .55
1018	lb.	.28	/ .515
1028, 1038, 72217, 75167, 75223	lb.	.33	/ .565
1308	lb.	.27	/ .505
1406	lb.	.415	/ .465
1706	lb.	.385	/ .62
71329	lb.	.275	/ .51
72285	lb.	.3375/	.5725
75179	lb.	.335	/ .57
78096	lb.	.395	/ .63
78197	lb.	.32	/ .55
78207	lb.	.29	/ .525
78210, 78211	lb.	.335	/ .57
78216	lb.	.31	/ .545
78343	lb.	.285	/ .52
Plastiflex, std.	lb.	.90	/ 1.10
Novelty	lb.	1.15	/ 1.50
Pliovic AO	lb.	.28	/ .32
VO	lb.	.265	/ .305
DB 80 V, DB 90 V, EDB 90V, K 90, S 50, S 70	lb.	.235	/ .275
Reynolon PVA/4-6, roll stock 1 mill	lb.	1.85	/ 3.25
1½, 2, 3, 4, 5, 6, 8 mill	lb.	1.60	/ 3.00
Satinflex	lb.	1.15	/ 1.50
Vygen 85	lb.	.43	/ .80
105, 161	lb.	.43	/ .93
110	lb.	.43	/ 1.08
120	lb.	.43	/ 1.18
Vinac RP-250	lb.	.55	/ 1.03

Vinylidine

Dow Latex 744-B	lb.	.26	/ .43
Resin 565	lb.	.39	/ .525
Saran formulation 115, black, nat.	lb.	.39	/ .52
747 nat.	lb.	.395	/ .525
761 nat.	lb.	.39	/ .52
Colors	lb.	.44	/ .69
820 nat.	lb.	.42	/ .55
Colors	lb.	.47	/ .60

Latices	lb.	$0.45 /	$0.62
Resin F 120	lb.	.58 /	.65
F242	lb.	.54 /	.60

Solvents

Eccostrip 57	lb.	1.50	
Enjay acetone	lb.	.085 /	.125
Isopropyl acetate	lb.	.115 /	.155
Alcohol, 91%	gal.	.42 /	.68
95%	gal.	.44 /	.70
Anhydrous	gal.	.46 /	.72
Ether	gal.	.30 /	.54
Methyl ethyl ketone	lb.	.125 /	.165
Secondary butyl acetate	lb.	.1225/	.1625
Alcohol	lb.	.125 /	.165

Stabilizers

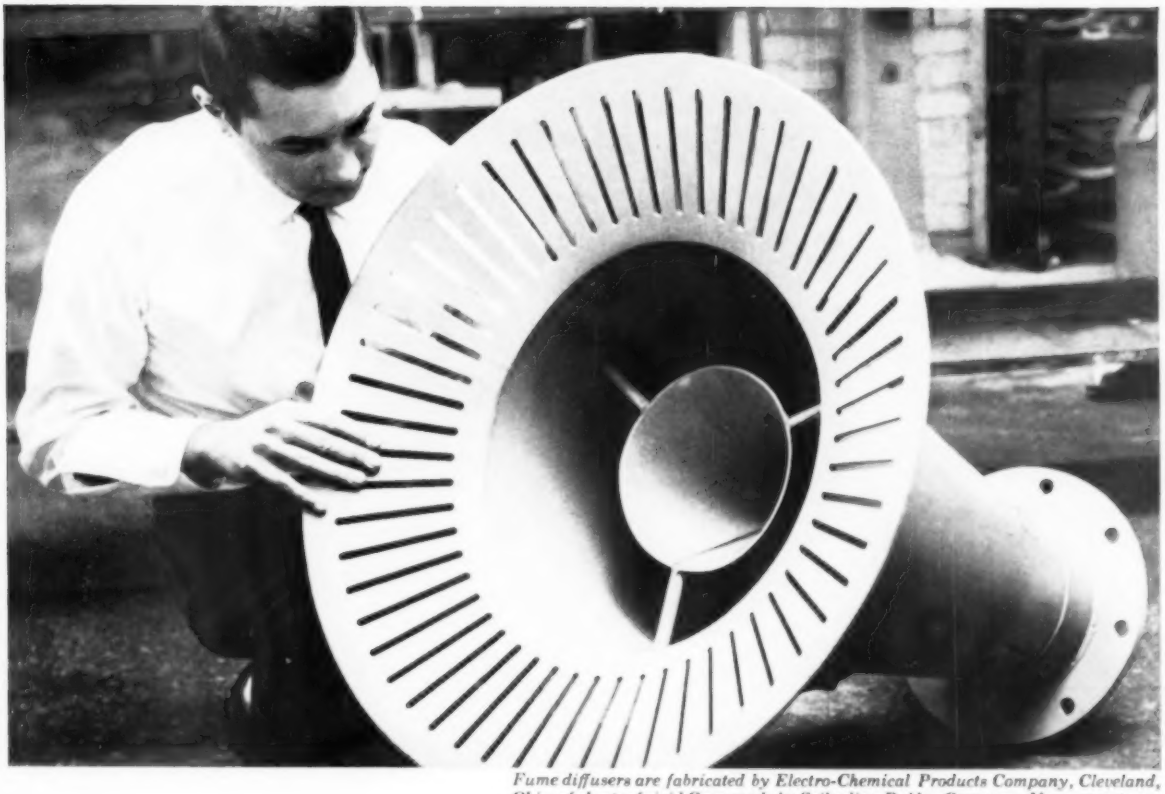
Advastab B-13-P, BC-105, BC-147	lb.	.75 /	.80
BC-12, C-77, C-79, E-82	lb.	.90 /	.95
BC-74, BC-30	lb.	.70 /	.75
BZ-51, L paste, Z-6, Z-15	lb.	.65 /	.70
BZ-155	lb.	.69 /	.74
C-21	lb.	1.00 /	1.05
CH-101, CH-201	lb.	.60 /	.65
CZ-11	lb.	.95 /	1.00
E-98	lb.	.53 /	.58
JCX	lb.	.62 /	.67
SN	lb.	.47 /	.52
T-10, T-52	lb.	1 90 /	1 95
T-17M	lb.	2 95 /	3.00
T-50LT	lb.	3.20 /	3 25
T-52N	lb.	1 80 /	1 85
T-72, T-671	lb.	2.65 /	2.70
Argus Mark C	lb.	.88 /	.95
E	lb.	.72 /	.85
M	lb.	.68 /	.74
PL	lb.	.63 /	.69
TT	lb.	.72 /	.86
WS	lb.	.98 /	1 11
X	lb.	2.50 /	2 75
XI	lb.	.87 /	1.01
XV	lb.	.92 /	.99
XX	lb.	.58 /	.65
Argus Mark A	lb.	2.80 /	3.15
C	lb.	.81 /	.84
E, TT	lb.	.72 /	.77
GS	lb.	.77 /	.80
M	lb.	.59 /	.62
PL	lb.	.62 /	.65
X	lb.	2.50 /	2.75
XV	lb.	.84 /	.87
XX	lb.	.57 /	.60
XI	lb.	.87 /	.90
WS	lb.	.97 /	1.00
Barca 10	lb.	.75 /	.80
Baker barium ricinoleate	lb.	.70	
Calcium ricinoleate	lb.	.55	
Zinc ricinoleate	lb.	.60	
Dutch Boy Barinac	lb.	.70	
Calstar	lb.	.37	
Clarite A	lb.	.83	
B	lb.	.68	
CS-137	lb.	1.25	
DS-207	lb.	$0.55	
Dyphos	lb.	.58 /	$0.595
50A	lb.	.34	
Dythal	lb.	.395 /	.41
Leadstar	lb.	.39	
Lectro 60	lb.	.2525	
Normal lead maleate	lb.	.4475	
Normasal	lb.	.46	
Pearlescent pigment	lb.	1.00	
Plumb-O-Sil-A	lb.	.3075	
-B	lb.	.325 /	.37
-C	lb.	.3475/	.375
Provinite A	lb.	.83	
B	lb.	.68	
Tribase	lb.	.275	
-E	lb.	.2225	
Trimal	lb.	.435	
Ferro 182	lb.	.70 /	.76
200	lb.	1.31 /	1.43
203, 900, 1820	lb.	.88 /	1.00
503	lb.	.28 /	.40
541A	lb.	.80 /	.92
700	lb.	.47 /	.59
703, 1972	lb.	.63 /	.75
823	lb.	2.50 /	2.75
840	lb.	3.25	
903	lb.	.58 /	.70
909	lb.	.91 /	1.01
1203	lb.	1.30 /	1.40
1206	lb.	1.23 /	1.33
1212	lb.	.68 /	.80
1825	lb.	.98 /	1.10
1840	lb.	.73 /	.85
1976	lb.	.45 /	.57
Harshaw 1-V-3	lb.	.43 /	.45
1-V-4	lb.	.665 /	.70
1-V-7, 1-V-26	lb.	.66 /	.68
2-V-4	lb.	.85 /	.87
2-V-5	lb.	1.09 /	1.12
5-V-1	lb.	.41 /	.43
7-V-2	lb.	.93 /	.95
8-V-1	lb.	.88 /	.90
8-V-21	lb.	.63 /	.65
8-V 100, 10-V-442	lb.	.82 /	.84
9-V-1	lb.	.70 /	.72
12-V-5	lb.	.73 /	.75
12-V-6	lb.	.92 /	.94
12-V-63	lb.	.72 /	.74
12-V-64	lb.	.68 /	.70
19-V-1	lb.	.52 /	.54
24 V-1	lb.	1.10 /	1.12
128-V-5	lb.	.86 /	.88
Meriz AST Concentrate 1001	lb.	.355 /	1.75
Metasap 613-A	lb.	.69	
613-B	lb.	.84	
613-C	lb.	1.06	
621	lb.	.88	
624	lb.	.75	
Cadmium stearate	lb.	1.40 /	1.44
Fused stearates, calcium 602-A	lb.	.25 /	.30
Dibasic lead stearate	lb.	.55 /	.60
Lead 611	lb.	.32 /	.38
Lead stearate	lb.	.43 /	.47
Nuostabe V-1	lb.	.55 /	.60
V-2	lb.	.36 /	.41
V-10	lb.	.67 /	.80
V-12	lb.	$0.5525/	$0.6825
V-14	lb.	.39 /	.52
V-20	lb.	1.27 /	1.40
V-21	lb.	1.07 /	1.20
V-40	lb.	1.25 /	1.38
V-50	lb.	.46 /	.59
V-60	lb.	.39 /	.44
V-82	lb.	2.37 /	2.50
V-122	lb.	.84 /	.91
V-130	lb.	.87 /	.94
V-131, V-171	lb.	.72 /	.79
V-132	lb.	.67 /	.74
V-133	lb.	.97 /	1.04
V-141	lb.	.57 /	.64
V-142	lb.	.81 /	.88
V-152	lb.	.62 /	.69
V-183	lb.	2.50 /	2.79
V-205	lb.	.78 /	1.58
Permyl A	lb.	.45 /	.57
Stabelan E	lb.	1.40 /	1.50
HR, liquid	lb.	.65 /	.75
Paste	lb.	.85 /	.95
Powder	lb.	.95 /	1.05
XL	lb.	.55 /	.65
Staflex QMXA	lb.	.70	
50% in DOP	lb.	.52	
OY	lb.	1.00 /	1.20
Stayrite #10	lb.	.33 /	.37
#15	lb.	.54 /	.57
#20	lb.	.38 /	.42
#22	lb.	1.32 /	1.34
#25	lb.	.36 /	.40
#70, 75, 80, 90	lb.	.69 /	.70
#229	lb.	.47 /	.50
P-10	lb.	.40 /	.44
Thermolite 12	lb.	2.00 /	2.25
13	lb.	3 10 /	3.78
13	lb.	4 13	
17	lb.	2.45 /	2.75
20	lb.	2.95 /	3 25
39	lb.	2 75 /	3.25
91	lb.	3.00	
Vanstay A	lb.	.51 /	.53
AB	lb.	.47 /	.49
HT	lb.	.88 /	.90
HTA	lb.	.98 /	1.00
HTB	lb.	.71 /	.73
HTC	lb.	1.10 /	1.12
L	lb.	.33 /	.35
R, X	lb.	.68 /	.70
RZ-25	lb.	.67 /	.69
S	lb.	.58 /	.60
SA	lb.	.82 /	.84
W	lb.	1.23 /	1.25
Z	lb.	.63 /	.65

Wetting Agents

Adawet 212	lb.	.45 /	.50
Meriz Wash Concentrate	lb.	2.59 /	3.69
Nuosperse 657	lb.	.48 /	.56
Poly-lube No. 4	qt.	1.45 /	1.94

News about

B.F.Goodrich Chemical *raw materials*



Fume diffusers are fabricated by Electro-Chemical Products Company, Cleveland, Ohio, of sheets of rigid Geon made by Seiberling Rubber Company, Newcomerstown, Ohio. B.F.Goodrich Chemical Company supplies the Geon polyvinyl material only.

FUME DIFFUSERS TOOK A LICKING FROM CORROSION

. . . till the cones were made from GEON

THESE cones of Geon rigid vinyl show how you can solve corrosion problems. They are used to diffuse hydrofluoric and chromic acid fumes in a chemical plant, where cones of metal and other plastic were tried first.

Geon rigid vinyl solves corrosion problems—because it withstands acids, oils and many hydrocarbon chemicals. Geon also provides for accuracy in fabrication. For example, the sheet of rigid Geon from which these cones were made was machined to extremely close tolerance—.003 inches for the slots—to give the cones the exact design for most efficient fume dispersion.

Products of versatile Geon polyvinyl materials can be made in rigid form, rotationally cast, slush molded, calendered, extruded or blown into foam form. Applications range from solving all types of corrosion problems from piping to ductwork, to coatings for paper, metal and other materials.

For information on Geon polyvinyl raw materials, write Dept. AH-1, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical Company
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B.F.Goodrich

GEON polyvinyl materials • HYCAR rubber and latex
GOOD-RITE chemicals and plasticizers • HARMON colors

Makers of top-selling quality toys pick MARLEX*

...for rigidity, toughness, gloss and molding accuracy!

Toy manufacturers everywhere are beginning to realize the many advantages of switching to high-quality MARLEX linear polyethylene. Toys made of MARLEX have integral color that lasts and lasts—even after years of abuse. Children are protected against irritations because MARLEX is nonallergenic. Toys of MARLEX are easy to keep clean. They can be wiped with a sponge, washed in dishwashers, or even sterilized in boiling water. Toys made of MARLEX are tough, attractive and durable.

No other material serves so well and so economically in so many different applications. How can MARLEX serve you?

*MARLEX is a trademark for Phillips family of olefin polymers.

Child Guidance Toys picked MARLEX because of its excellent rigidity, toughness, gloss and molding accuracy. Their new Spinning Fan, Steam Iron and Mechanics Bench are excellent examples of colorful, durable, intricately molded toys that can be profitably made with MARLEX resin. The fan, for example, features self-lubricating MARLEX bevel gears.

This toy sports car and fire truck have numerous parts made of MARLEX...the tough, stiff, unbreakable roof, grille and bumper units, the fire ladder, and the self-lubricating cam mechanism. Trimold, Inc., Buffalo, N. Y., who molds these items for Fisher-Price Toys, says, "Color won't bleed into MARLEX from adjacent painted wood parts because MARLEX is impermeable."

Fun for young and old... the "Jeri Wheel" is molded by Arrow Plastic Molders of Inglewood, Calif. for the Original Jeri Wheel Co. This modern version of an old standby has removable metal weights for changing rolling action. Because it's made of MARLEX, the "Jeri Wheel" won't mar floors. MARLEX is unbreakable . . . nonallergenic . . . safe for children.

PHILLIPS CHEMICAL COMPANY, Bartlesville, Oklahoma

A subsidiary of Phillips Petroleum Company

PLASTICS SALES OFFICES

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East Providence 14, R.I.	New York 5, N. Y.	Akron 8, Ohio	Elmhurst, Ill.	Pasadena, Calif.	Dallas, Texas	New York 5, N.Y.
GEneva 4-7600	Digby 4-3480	FRanklin 6-4126	TErrace 4-6600	RYan 1-6997	EMerson 8-1358	Digby 4-3480

MARLEX